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Series I.

Number IV.

BULLETIN

OF THE

University of Notre Dame

NOTRE DAME, INDIANA



ENGINEERING NUMBER

1905 - 1906

PUBLISHED QUARTERLY AT NOTRE DAME

UNIVERSITY PRESS

APRIL, 1906

Entered at the Postoffice, Notre Dame, Indiana, as second class matter, July 17, 1905.

DIRECTORY OF THE UNIVERSITY.

The FACULTY—Address:

THE UNIVERSITY OF NOTRE DAME,
NOTRE DAME, INDIANA.

The STUDENTS—Address:

As for the faculty, except that the name of the
HALL in which the student lives should be added.

A Postoffice, a Telegraph Office, a Long Distance
Telephone, and an Express Office are at the University.

The University is two miles from the city of South
Bend, Indiana, and about eighty miles east of Chicago.
The Lake Shore and Michigan Southern, the Grand
Trunk, the Vandalia, the Indiana, Illinois & Iowa, and
the Michigan Central railways run directly into South
Bend.

CALENDAR FOR 1905-1906.

- SEPTEMBER 12. Examinations of Conditioned Students.
13-14. Entrance Examinations.
15. Colleges open.
17. Reading of University Regulations in all the Halls.
- OCTOBER 13. Founder's Day.
27-28. Bi-Monthly Examinations.
29. Annual Retreat begins in the evening.
- NOVEMBER 1. Feast of All Saints.
30. Thanksgiving Day.
- DECEMBER 5. Contest in Oratory.
8. Feast of the Immaculate Conception.
18-19. Winter Examinations.
19. Christmas Vacation begins.
- JANUARY 5. Colleges open.
- FEBRUARY 2. State Oratorical Contest.
22. Washington's Birthday.
23-24. Bi-Monthly Examinations.
- MARCH 17. St. Patrick's Day.
19. St. Joseph's Day.
- APRIL 15. Easter. *No Easter Vacation.*
16. Easter Monday.
24-25. Bi-Monthly Examinations.
- MAY 1. Latest Date for handing in Prize and Graduation Essays in all Collegiate Courses.
16. Contest in Elocution.
30. Decoration Day.
- JUNE 4-9. Examination of Graduates.
10. Baccalaureate Sermon.
11-13. General Examinations.
13. Commencement. Preliminary Exercises
7:30 P. M.
14. Graduation Exercises, 8:00 A. M.

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UNIVERSITY OF NOTRE DAME.

The University of Notre Dame was founded in the year 1842, by the Very Reverend Edward Sorin, the late Superior General of the Congregation of Holy Cross. In an act approved January 15, 1844, the Legislature of Indiana gave the University power to grant degrees. The beginning of this act is:

"Be it enacted by the General Assembly of the State of Indiana, that Edward Frederick Sorin, Francis Lewis Cointet, Theophilus Jerome Marivault, Francis Gouesse, and their associates and successors in office, be, and are hereby constituted and declared to be, a body corporate and politic, by the name and style of the 'University of Notre Dame du Lac,' and by that name shall have perpetual succession, with full power and authority to confer and grant or cause to be conferred and granted, such degrees and diplomas in the liberal arts and sciences, and in law and medicine, as are usually conferred and granted in other universities in the United States, provided, however, that no degree shall be conferred or diplomas granted, except to students who have acquired the same proficiency in the liberal arts and sciences, and in law and medicine, as is customary in other universities in the United States."

UNIVERSITY BUILDINGS.

THE MAIN BUILDING.

The dimensions of this building are 320 by 155 feet ; it is five stories in height and is surmounted by a dome 207 feet in height. The executive offices, two study-halls, some dormitories and class rooms and the dining-rooms are in this building. The Library and the Bishops' Memorial Hall are also here temporarily. This building, like all others in the University, is lighted by electricity and gas, and heated by steam. The corridors of the first floor are decorated with mural paintings by Gregori.

THE CHURCH.

The Church of the Sacred Heart is 275 by 120 feet in ground dimensions and 125 feet in height from the floor to the roof-ridge. The interior is decorated by Gregori, and the architecture is Gothic. There is a large crypt and many chapels. In the tower are a chime of 32 bells and the great six-ton chief bell.

THE LIBRARY.

The Library contains 55,000 volumes. Students have access to it from 8:00 a. m. to 9:00 p. m.

WASHINGTON HALL.

This hall is 170 feet in length, 100 feet in width, and about 100 feet in height. It contains the rooms of the Department of Music, the reading rooms for Brownson and Carroll Halls, and the University Theater. The Theater is elaborately equipped with stage settings. It will seat 1,200 persons.

SCIENCE HALL

is situated a few steps south of Washington Hall. Its dimensions are 104 by 131 feet, and it is three stories in height. A large central space, the full height of the building, is occupied by a museum containing mineral, fossil, and biological specimens.

THE CIVIL ENGINEERING DEPARTMENT

occupies a portion of the basement of Science Hall as a laboratory. The lecture rooms are in the main building. The equipment of this department is sufficient for all the practice and exercises in the field necessary to illustrate and teach the practical methods of engineering. The instrumental outfit consists of one surveyor's transit, three engineer's transits with levels and vertical circles attached to telescopes, also solar attachment, two engineer's wye levels and a plane table with all the attachments, clinometers, chains, tapes, levelling rods, etc., and one Olsen's cement testing machine.

THE CHEMICAL DEPARTMENT

occupies the entire north side of the first floor of Science Hall. Adjoining the general museum, is a large and well-lighted room reserved for a library and chemical museum. Here are a library of chemical journals and books, and a steadily increasing collection of minerals, chemicals, and chemico-technical products of all kinds, designed to serve as illustrations of substances and processes, discussed in the various lecture courses. Adjoining this room are successively, an apparatus room, filled with the most modern apparatus for lecture and experimental work; a chemical store-room, where laboratory supplies may be procured by the students; a lecture room, and a laboratory for qualitative and quantitative analysis. The laboratory is fur-

nished with hoods, of good draught; the desks are provided with water, gas, and the necessary reagents, and fully equipped with apparatus for work in gas analysis, organic analysis, and with apparatus for "Boiling Point and Freezing Point Determinations." The Balance Room, adjoining, contains assay and analytical balances sensitive to one ten-thousandth of a gramme. The lecture room is provided, among other things, with apparatus for stereopticon illustration, with electric batteries, and with a complete set of charts illustrative of the process employed in modern chemical industries.

The assay and furnace room, in the basement, is equipped with a set of gas furnaces of the most modern type, for the operations of roasting, fusing, scorifying and cupelling employed in the dry assay of ores.

The Department of

PHYSICS AND ELECTRICAL ENGINEERING

is located in the south wing. There is a large lecture room, with a seating capacity of sixty-five students, adjoining the rooms in which the apparatus is stored in dust-proof cases. Several smaller rooms in the basement contain heavy piers of masonry, for work with sensitive galvanometers.

The following is a partial list of the more important pieces of apparatus in the Physical Laboratories:

IN MECHANICS, ETC.:

Large physical balance,	Compound pendulum,
Standard kilogram,	Break circuit recording chronograph,
Standard metre,	Powerful hydraulic press with attachments,
Geneva cathetometer, capable of measuring to one twenty-five thousandth of an inch,	Rotary air pumps and receivers,
Dividing engine,	A large clock with electrical contact pieces,
Atwood's machine,	

Self-winding clocks,
Several mercury barometers,

Two aneroid barometers.

IN ACOUSTICS:

A Mercadier radiophone,
Set of Koenig resonators,
Set of electrically - operated
tuning forks by Koenig,
A Scott-Koenig Phonautograph,
Edison phonograph of earliest
type,
Sets of vibrating rods, tubes
and bells,
Large double siren,
A set of very small tuning forks
producing the highest audible
sounds,
A set of resonators mounted to
gether with capsules for sen-
sitive flames, arranged for the
analysis of complex sounds,

Koenig's movable tuning forks,
to draw compound curves on
smoked glass,
Three sets of organ pipes,
Four sets of fine tuning forks,
Apparatus for manometric
observation of sound pheno-
mena,
A large tuning fork producing
the lowest audible sound,
Apparatus for producing longi-
tudinal vibrations in rods,
An electrical metronome,
Mounted tuning forks carry-
ing small mirrors arranged
to perform Lissajou's experi-
ment, producing complex
curves.

IN LIGHT:

Complete set of apparatus,
made by Soleil, Paris, for the
measurement of the wave
length of light by various
interference methods,
Sets of polarization apparatus,
Sets of lenses and spherical
mirrors,
Two heliostats,
Four spectrosopes,
A polarizing saccharimeter,
Three projecting lanterns for
gas or electric light, and
3,000 slides,

Set of large Nicol's prisms
mounted,
Large compound prism to form
widely dispersed spectrum,
Two Rowland gratings, 14,000
lines to the inch,
Set of photographs of solar
spectrum by Rowland,
Several cameras with lenses
and attachments,
A well equipped dark-room for
photographic work,
Photometric room and equip-
ment.

IN HEAT :

Melloni's apparatus for measuring radiation, absorption and reflection of heat, complete with a set of prepared substances,
 Standard thermometers,
 Air thermometers,

Steam engine indicator,
 Calorimeters,
 Apparatus for determining the coefficient of linear expansion, using the optical lever method.

IN ELECTRICITY AND MAGNETISM :

An absolute electrometer,
 Holtz machine and apparatus for illustrating static phenomena,
 Four induction coils,
 Six bridges of different types,
 Ammeters and voltmeters,
 One 2,000 lb. electro magnet,
 Standard resistance coils,
 Several sets of storage cells,

Historical set of motors showing evolution of the modern machine from the early forms of the reciprocating type,
 Ten galvanometers of various types,
 Complete X-ray outfit,
 Sets of apparatus for wireless telegraphy.

In addition to the electrical apparatus in the Department of Physics, the equipment for practical work in Electrical Engineering consists of engines, dynamos, instruments, etc., of commercial size, as follows :

A three phase A. C. induction motor, arranged to operate on single phase circuits, with a condenser compensator,
 A high frequency 1000 V., 33 K. W., composite wound, Wood alternator of the latest type with excitator and a full set of switchboard instruments,
 Several transformers of different capacity,
 A high tension transformer for testing insulation,
 An Edison bipolar 15 K. W. 125 V., generator,

A Thompson-Houston arc light machine with regulator and fifteen lamps,
 A Wood arc machine, capacity 25 lights,
 An Edison bipolar 3 K. W. 125 V., dynamo, with special winding,
 A Van Depoele compound wound dynamo,
 A special A. C. and D. C. 5 H. P. dynamo or rotary converter,
 A series wound dynamo with wrought iron field,
 A number of small motors,

- A forty horse power high speed automatic engine,
- A set of inclined coil alternating current portable instruments; voltmeter, ammeter and wattmeter,
- A set of tools for metal working,
- Telegraphing relays, sounders, switchboards, etc.,
- Telephone apparatus, including subscribers sets of various modern types, a fifty drop manual switchboard complete and a lot of separate drops, jacks, switches, lightning arresters, etc.,
- Automatic telephone switchboard containing first and second selector and connector switches, interrupter heat coils, etc., and three subscribers sets. With this apparatus all the operations involved in the operation of a 10000 system may be performed,
- A complete central energy switchboard, several lines and subscribers sets and a selective signaling four party line outfit,
- A collection of historical sets, including Reis' transmitter and receiver,
- Standard portable bridge,
- Common portable bridge,
- Testing battery,
- A power or foot lathe with wood turning tools, drills and hand tools for metals,
- A calibrating lamp rack,
- D'Arsonval and common galvanometers,
- Ballistic galvanometer, standard condenser, etc., for capacity work,
- Resistance boxes, standard megohms, etc.,
- High resistance Thompson galvanometer,
- Standard cells,
- Voltmeter arranged for the comparison of incandescent lamps,
- A plug switchboard controlling all circuits,
- A small engine belted to shafting to drive a plating dynamo and a buffer for cleaning and polishing work to be plated; solution, tank, etc.,—in all, a complete outfit for electrotype work,
- A hot wire ammeter,
- Twelve ammeters and voltmeters, mostly of the Weston type for direct current measurements,
- A set of wood working tools,
- Kohlrausch bridge for measuring battery resistance, etc.,
- A lot of arc lamps, series and constant potential, open and enclosed arcs of various types,
- A dynamometer type wattmeter,
- Recording wattmeters of various types,
- A collection of motor starting rheostats,
- A set of parts of incandescent lamps showing the various stages in their manufacture,

- A large collection of porcelain insulators, etc., used in electrical work, including a lot of insulators for high tension transmission lines,
- A lot of armature core disks, transformer core stampings, formed coils, brush holders, pole pieces, samples of insulation, commutator segments, etc., used in dynamos of good design, donated by leading manufacturers of electrical machinery,
- A case of marked samples of wire insulators, lamps, and other construction materials,
- Library of practical technical books of reference and files
- of leading periodicals and trade publications,
- A Cooper Hewitt mercury vapor lamp,
- A high frequency Tesla coil and condenser,
- A working model of the induction motor showing the action of the rotating field,
- A transmission dynamometer capacity $\frac{1}{4}$ to 10 horse power for determining the efficiency of small dynamos.
- Full size armature winding models mounted to rotate in bipolar and multipolar fields,
- A storage battery, 25 cells with universal switch to connect for various voltages.

EQUIPMENT IN THE DEPARTMENTS OF BIOLOGY, GEOLOGY, AND MINERALOGY.

The department of Biology, on the north side of the second floor of Science Hall, consists of three large classrooms and laboratories properly ventilated and lighted. There are also private laboratories set apart for post-graduate students. All the class-rooms are furnished with charts and models necessary in teaching the different courses. The arrangement of windows is such that the rooms can be easily darkened so that a stereopticon and lantern slides on the subjects of Botany, Zoology, and Physiology may be used.

The laboratories are well equipped with compound and dissecting microscopes, and in each room there is a library of books pertaining to biological subjects. The botanical laboratory contains twenty-four compound microscopes and all the requisite accessories for work in

Vegetable Histology and Cryptogamic Botany. The general laboratory of Microscopy, Histology and Embryology is also supplied with compound microscopes and the equipments indispensable in the courses mentioned above.

The bacteriological laboratory is completely equipped with compound microscopes, incubators, sterilizers, and all the improved apparatus employed in thorough and careful work in Bacteriology. Apart from the others is a laboratory of Photo-Micrography which contains a perfect photo-micrographic instrument with a complete set of accessory apparatus for experimentation, photographing microscopic objects, making lantern-slides, etc. A large and fully equipped dark-room adjoins this laboratory.

The south side of the second floor consists of classrooms and laboratories for the courses in Geology and Mineralogy. The laboratories adjoining the classrooms are well equipped for work in blow-pipe analysis and assaying.

THE MUSEUM.

connected with the departments described above, is well arranged for convenience of study. The zoological collection on the second floor at present fills sixteen large cases and represents typical forms of all the orders and genera of vertebrate and invertebrate animals. A large collection of representative vertebrate skeletons has recently been added to this part of the Museum.

The botanical collection, also on this floor, consists of two complete Herbaria, one of the United States, the other of Canada. There is also a second collection of the woods and fruits of the United States, almost complete.

The collections in Geology and Mineralogy occupy the

first floor. These collections are arranged in a series of cases on each side of the building. In one series is a carefully classified collection of minerals and ores. The opposite series of cases contains a large geological collection; some of the specimens here are of the rarest fossil remains of animal and plant life.

ENGINEERING HALL.

This building is situated in the southern part of the grounds and is a large two-story brick building, well lighted and heated. The lower floor contains the mechanical laboratory, machine shop, blacksmith shop and foundry. The second floor is given up to the wood shop and also contains a well lighted drawing room where students in designing may consult complete working drawings of the best steam engines and pumps to be found on the market.

The wood shop is supplied with modern work-benches fully equipped with the smaller tools necessary for carpentry, lathes for turned work, two jig saws, a pony planer, a joiner, circular saw and band saw, the whole forming an adequate equipment for a thorough mastery of joinery, scroll work and pattern making.

The machine shop contains two horizontal slide valve steam engines which are used for experimental purposes. The power for operating the machine shop is derived from the electric plant of the University, two ten-horse power motors being used for this purpose, from which power is transmitted to the various machines by line shafting running the entire length of the building. The latest improved lathes have been provided, nine in number, varying from a five inch swing in the smallest to a large engine lathe with sixteen foot bed having a capacity for work twenty-eight inches in diameter. Two drill presses, a large planer, a shaping machine and a

Brown and Sharp milling machine complete the outfit, thus making the machine shop a model of its kind. During the past year there have been completed in the machine shop seven new screw cutting lathes of fourteen inch swing, one twenty-eight inch Sibley and Ware drill-press, one horizontal 8 by 12 slide valve steam engine and a wood milling machine which will be added to the equipment in the new building. It is the policy of this department to refrain as much as possible from exercise work and each student is usually taking part in the construction of some new machine or engaged on general repair work for the University which is regarded superior to a fixed routine of exercises.

The blacksmith shop has the usual complement for teaching forging, annealing, welding and tool making. In the foundry work the student is instructed in the proper disposition of gates and sprues, the mixing of sand, setting up and drawing simple and complicated patterns and core making. This is supplemented with lectures on the proper mixing and heating of cast iron for the various purposes for which it is used.

In addition to the facilities afforded by the shops, the engineering students have access to the steam and power plants of the University which have been recently remodeled and made to compare favorably with the best contemporary practice. The main steam plant contains two batteries of ten horizontal tubular boilers, aggregating 1200 horse power. In connection with the boilers is installed the necessary testing apparatus as follows:—a Worthington hot water meter for measuring the amount of feed water, a feed water thermometer for getting temperature of same, a high range thermometer for temperature of generated steam, a throttling calorimeter for ascertaining the quality of steam and an automatic recording pressure gauge giving a continuous record of

the boiler pressure. Provision is made for finding the temperature and pressure of the flue gases by means of a pyrometer and draught gauge and for obtaining samples of flue gas for analysis. These, with a Carpenter coal calorimeter for determining the heating value of fuel, comprise a full and complete equipment for giving the student an intimate knowledge of the practical part of boiler management and testing. A Webster feed water heater and purifier, two compound duplex pumps, two vacuum pumps working on the heating system, two large Worthington fire pumps 16 by 9 by 12 with a capacity of 1500 gals. per minute, with numerous separators, steam traps, automatic reducing valves, etc., complete the apparatus in the main steam plant. A McEwen high speed automatic engine, an Armington and Simms engine of similar type and several low speed horizontal engines with planimeters, indicators, reducing wheels, slide rules and other necessary instruments, are used in studying the operation of the steam engine, distribution and economy of steam, regulation, valve setting and heat wastes.

In the gas engine laboratory are installed one horizontal ten-horse power four cycle gas engine completely equipped for experimental runs, a five horse power two cycle vertical gas engine of the marine type, one Mot-singer Auto-sparker with induction coil, one Apple Ignition dynamo with storage battery, a Hendricks Automatic Igniter together with carburettors, spark plugs, spark coils, indicators, and all necessary equipment for a complete study of the gas engine.

THE CHEMICAL LABORATORIES

occupy a large three story building directly south of Science Hall. The entire first floor is devoted to advanced work and space is given to two large laboratories and lecture rooms. The second floor is occupied

by the Department of Pharmacy, and contains a large well-equipped laboratory, a modern drug store, a lecture room and museum a library for pharmaceutical publications, and a general stock room. The general Inorganic, Organic and Elementary Chemical laboratories are on the third floor. Each laboratory is provided with ample hood accommodations, and each desk is furnished with water, gas, and suction.

SORIN HALL.

This building is 144 feet in length, with two wings 112 feet in depth. It has a basement and three high stories, and contains 101 private rooms for advanced students. These rooms are furnished, and students of Senior, Junior, or Sophomore standing in any of the Colleges are not required to pay rent. On the first floor there is a chapel, a law lecture room, and a law library. The building is lighted with electricity and heated with steam. In the basement are recreation rooms and bath rooms.

CORBY HALL.

Corby Hall is a second residence building. It has three stories and a basement, and it is 240 feet in width. There are 125 private rooms for students, with recreation rooms and a chapel. The building is lighted with electricity and gas and heated with steam. For room-rent and care of the room a fee is charged.

THE OBSERVATORY.

This building is located near the Chemical Laboratories and is designed for an equatorial telescope and for a transit or meridian circle. The equatorial telescope now in the building is intended for students of Astronomy, and is in use whenever favorable weather permits.

THE INFIRMARY.

This building, 200 feet by 45 feet in ground measurement and three stories in height, contains rooms for the use of students during illness. The sick are nursed by Sisters of the Holy Cross, and the University physician visits them daily.

THE GYMNASIUM.

The gymnasium which was burnt down in November, 1900, was replaced by a building 230 by 200 feet in dimensions. The track-hall is now 100 by 180 feet on the ground: it is used for indoor meets, winter baseball practice, basketball and military drill. The gymnastic hall is 100 by 40 feet and is furnished with a full set of new apparatus; below that are the offices, dressing-rooms and showerbaths. Friends of the University and the alumni contributed more than \$3,000 to the fund for rebuilding.

The Cartier Field is an enclosed field for athletic games. There is a permanent grand stand near the baseball diamond and the cinder track, and a portable stand near the football rectangle. The field contains ten acres of ground, and is a gift to the University from Mr. Warren A. Cartier, C. E., of the class of '87.

OTHER BUILDINGS.

There are numerous other large buildings connected with the University; of these the principal are: Saint Joseph's Hall, Holy Cross Hall, the Community House, the Presbytery, and Saint Edward's Hall.

DISCIPLINE.

Official bi-monthly reports of each student's class standing will be sent to parents and guardians.

The Faculty maintain that an education which gives little attention to the development of the moral part of a youth's character is pernicious, and that it is impossible to bring about this development where students are granted absolute relaxation from all Faculty government while outside the class-room. A young man must learn obedience to the law by the actual practice of obedience, not by mere appeals to honor.

Moreover, the quiet and concentration of mind that are needed for collegiate work are not obtained except where discipline exists.

Therefore the following regulations, shown to be salutary by experience, are enforced at the University :

1. No student shall leave the University grounds without permission from the President or the person delegated to represent him.

2. *Leave of absence will not be granted to students during the term time, except in cases of urgent necessity. There is no vacation at Easter.*

3. Students are required to report at the University immediately after arriving at South Bend. This rule is binding not only at the beginning of the scholastic year, but at all other times when leave of absence has been granted. Unnecessary delay in South Bend is looked upon as a serious violation of rule.

4. *Flagrant disobedience to authority, cheating in examinations, the use of intoxicating liquors, immorality, the use of profane and obscene language, and an unauthorized absence from the University limits* are among the causes for

expulsion. In case of suspension or expulsion for such offences, *no fees will be returned.*

5. No branch of study shall be taken up or discontinued without the consent of the Director of Studies.

6. Preparatory students are enrolled in Brownson, Carroll or St. Edward's Hall according to age: boys seventeen years of age or older are placed in Brownson Hall; those over thirteen and under seventeen, in Carroll Hall; and those under thirteen, in St. Edward's Hall.

7. The use of tobacco is forbidden except to those students of Sorin, Corby and Brownson Halls who have received from their parents written permission to use tobacco.

8. Continued violation of regulations in Sorin or Corby Hall leads to forfeiture of rooms.

9. *Although students of all religious denominations are received, the University is nevertheless a strictly Catholic institution, and all students are required to attend divine service in the University Church at stated times.*

10. The use of intoxicating liquors is strictly prohibited.

11. Undue attention to athletics at the expense of study will not be permitted, but students are expected to take part in outdoor sports and other games.

12. A limited number of athletic contests is permitted with college organizations from without.

13. All athletic associations of the students are strictly forbidden to countenance anything that savors of professionalism.

14. All athletics are governed by a Faculty Board of Control which will be guided in its rulings by the regulations adopted by the Conference Colleges. The President of the University and members of the Faculty will compose this Board, and reserve the right of a final decision on all questions concerning athletics. The

Faculty Board will determine the amateur standing of the members of the athletic teams and apportion the finances. By this means indiscrete and unconsidered action of students will be checked.

LECTURES AND CONCERTS.

Each winter, eminent men are invited to lecture before the students. Among those who have addressed the University in the past few years may be noted four Apostolic Delegates: Cardinals Satolli and Martinelli, and Monsignors Falconio and Agius; Archbishops Ireland, Riordan, Keane, Glennon and Christie, and Bishops Spalding, Alerding, McQuaid, O'Gorman and Shanley. There were also such noted European churchmen as the Abbé Felix Klein and the foremost of living English historians, Dom Gasquet, besides men of letters like Marion Crawford, Maurice Francis Egan, Henry Van Dyke, Seumas MacManus, William Butler Yeats, James Jeffrey Roche, Hamilton Wright Mabie and Henry James, and such men of affairs as Senator Taft, ex-Senator Hill, Senator Beveridge, Secretary of Navy Charles Jerome Bonaparte, William P. Breen and Bourke Cockran. Concerts are given frequently by organizations from without.

EXPENSES.

Matriculation Fee (payable on first entrance)	\$ 10.00
BOARD, TUITION, (Latin, Greek and Modern Languages included) Lodging, Washing, and Mending of Linens, per Session of nearly Ten Months.....	400.00

PAYABLE IN ADVANCE, as follows:**On Entrance in September:**

Matriculation Fee (payable first year only)	\$ 10.00
First Payment on Board and Tuition	250.00
Deposit on Book and Stationery Account	10.00
Special Lecture and Concert Course	3.00

Also, in this First Payment must be included any extra Expense the student may wish to incur, such as charges for Private Room, Special Courses (listed below), and Spending Money.

On January 15:

Balance on Board and Tuition	\$150.00
and any extra expenses the student may have incurred.	

No rebate will be allowed for time absent at the opening of the Sessions, September and January. The charge of \$400.00 covers the tuition fee, which is fixed at \$100.00 per Scholastic Year. The latter sum is accepted as an entirety for tuition during the Scholastic Year, and will not be refunded in whole or in part if the student be dismissed for wilful infraction of the fundamental rules and regulations herein stated and hereby brought to his notice; and so likewise in the event of his leaving and absenting himself from the University at any time or for any cause without proper permission. However, an exception is made if it seems to be expedient for him to go to his home because of severe or protracted illness. *Degrees will not be conferred on any student whose account with the University has not been settled.*

SPECIAL EXPENSES—PAYABLE IN ADVANCE:

For whole Session of nearly Ten Months.

PRIVATE ROOMS—

Sorin Hall: Seniors, Juniors and Sophomores, Free;	
Freshmen	\$50.00
Corby Hall	80.00

While the students, as a rule, are advised to confine themselves to the regular studies of the course they have entered, any of the following may be taken at the rate mentioned per Scholastic Year. The charges will be *pro rata* for any portion of the year.

Instrumental Music—Lessons on Piano and use of Instrument.....	\$60.00	Use of each Instrument..	\$ 5.00
Use of Piano for Advanced Students.....	30.00	Vocal Culture.....	40.00
Telegraphy.....	25.00	Elocution — Special Course.....	10.00
Typewriting—Full Course (20 Lessons)	5.00	Use of Library.....	5.00
Phonography.....	25.00	"Scholastic"—College Paper.....	1.50
Practical Mechanics.....	30.00	Artistic Drawing....	25.00
Lessons on Violin, Guitar, Flute, Cornet, Clarinet or Mandolin.....	30.00	Applied Electricity.....	40.00
		Special Lecture and Concert Course.....	3.00
		Gymnastics—Full Course (20 Lessons).....	5.00

Laboratory Fees Listed under Regular Courses.

GRADUATION FEE.

For all Courses leading to a Degree, \$10.00; Commercial Course, \$5.00.

REMARKS.

The Entrance Fees, cost of Books, Music and Laboratory Fees, etc., are required with first payment.

Remittance should be made by draft, postoffice money order or express, payable to the order of the President.

Checks on local banks are not desirable, and exchange will be charged in all cases.

Term bills and other accounts are subject to sight draft if not paid within ten days after they have been rendered.

Sorin, Corby, Brownson and Carroll Halls are closed during the months of July and August. Students wishing to spend their Summer Vacation under the care of the University authorities can be accomodated at San José Park, Lawton, Michigan.

In consequence of benefactions lately received by the University, a limited number of students aspiring to the ecclesiastical state can be received at special rates. Fuller information can be obtained by addressing the President.

College of Engineering

Department of Civil Engineering

Department of Mechanical Engineering

Department of Electrical Engineering

1

COLLEGE OF ENGINEERING.

In the industrial development of a country the engineer takes an important part. Many new industries are springing up and the great activity in those already established throughout the world creates a demand for the services of trained engineers.

The programmes of studies in the three departments of engineering at Notre Dame are arranged to give a knowledge of the fundamental facts and theories that are applied in engineering work. Mathematics is foremost among these requirements. The natural sciences receive their share of attention and due importance is given to languages in arranging the programmes of studies.

Laboratory work and field work give a certain amount of practice in the application of the theory to actual physical conditions. These conditions are made to correspond as closely as possible to the real work of the engineer.

A student who has no liking for mathematics should not be encouraged to take up an engineering course. The successful engineer is one who thinks clearly and acts accurately. Clear thinking is necessary to master mathematical subjects and skill and accuracy are acquired by applying the results of mathematical calculations to particular practical cases in laboratory work.

Three regular programmes have been arranged; one leading to the degree of Civil Engineer, one to the degree of Mechanical Engineer, and one to the degree of Mechanical Engineer in Electrical Engineering.

Special Short Courses in Electrical and Mechanical Engineering are offered to accomodate those who wish

to fit themselves for practical work in the shortest possible time.

The various laboratories are equipped with the most approved forms of instruments and appliances and considerable time is given to technical work.

(For list of available apparatus, see pages 9-18.)

In the schedules of studies one hour credit is given for each recitation or lecture which requires from one to two hours' preparation. Two hours actual time in laboratory work or drawing are required for each hour on the schedule.

EXPENSES.

In addition to the regular fee for matriculation, board, tuition, lodging, etc., as given on page 24, the regular students in the three Engineering Courses are required to pay laboratory fees to cover, in part, the cost of materials consumed and the deterioration of the apparatus used, as follows :

LABORATORY RATES.

Physical Laboratory III.....	\$ 5.00
Physical Laboratory IV.....	15.00
Electrical Laboratory I., II.....	15.00
Electrical Laboratory IV.....	20.00
Shopwork, all four-hour courses, per term.....	15.00
Chemistry I.....	5.00
Chemistry II., IV., V., each.....	10.00

**PROFESSORS IN THE COLLEGE OF
ENGINEERING.**

REV, MARTIN REGAN, C. S. C.,
Christian Doctrine.

REV. ALEXANDER KIRSCH, C. S. C.,
Geology.

REV. JOSEPH MAGUIRE, C. S. C.,
Chemistry and Mineralogy.

REV. MATTHEW SCHUMACHER, C. S. C.,
English.

REV. JULIUS NIEUWLAND, C. S. C.,
Chemistry.

MARTIN J. McCUE, M. S., C. E.,
Civil Engineering and Astronomy.

FRANCIS XAVIER ACKERMANN, M. S.,
Drawing.

JEROME J. GREEN, M. E., E. E.,
Electrical Engineering and Physics.

WILLIAM LOGAN BENITZ, M. E., E. E.,
Mechanical Engineering.

EDWARD J. MAURUS, M. S.,
Mathematics.

CHARLES PETERSEN, A. M.,
German.

THOMAS JAMES DEHEY, A. M.,
French.

BENJAMIN R. ENRIQUEZ, C. E.,
Mathematics and Assistant in Civil Engineering.

WILLIAM B. KELLY,
Shopwork.

REGULATIONS GOVERNING ADMISSION TO THE COLLEGE.

Examinations in all the subjects required for admission to the University are held at Notre Dame in September, at the beginning of the Fall term.

A candidate failing to pass satisfactory examinations in one or more of the subjects required for admission to any Collegiate Course may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiency by extra study *within one school year*. Only when the conditions are removed will the student be admitted to full standing in his class.

Candidates for admission to advanced classes in any department are required to pass, *in addition* to the usual entrance examinations, an examination in the work already done by the classes they desire to enter. The additional subjects may be found in the programs of studies.

Certificates of work done in public or private High Schools will not be accepted instead of examinations, unless the applicant has passed the final examination after a full course in his school, and the Faculty of the University are satisfied with the standing of the school.

Graduates of High Schools that are *fully accredited* to the State Universities, will be admitted without examination to the Freshman Year of any department to which their preparatory studies entitle them.

Applicants for advanced standing who present certificates from other colleges or universities may be received at the discretion of the Faculty with or without examination as regards particular cases.

No student will be admitted to any course of the Senior Year until all conditions have been cancelled.

Catholic students who are candidates for any degree are required to take the prescribed Courses in Evidences of Religion.

**ACADEMIC REQUIREMENTS FOR ADMISSION TO THE
COLLEGE OF ENGINEERING.**

GEOMETRY—Plane and Solid, including the solution of simple original problems and numerical examples, as given in the works of Wentworth, Chauvenet, Newcomb, or an equivalent in treatises by other authors.

TRIGONOMETRY—Plane and Spherical.

ASTRONOMY—Descriptive.

CIVICS—Elementary.

HISTORY—General outlines of Ancient, Medieval and Modern History.

GEOGRAPHY—Physical, as much as is contained in Tarr's text-book or an equivalent treatise.

PHYSICS—Elementary. The preparation on this subject should include a course of lectures, illustrated by experiments, and recitations from a text-book similar to Carhart and Chute's or Gage's. Laboratory work is recommended, but is not required.

CHEMISTRY—The elements of Inorganic Chemistry as given in a High School.

BOTANY, PHYSIOLOGY AND ZOOLOGY—As given in elementary text-books.

MODERN LANGUAGE—Engineering students must present a two years' course in German.

ENGLISH—Part of the examination time is given for answering questions upon books required to be read in the preparatory courses in English; the remainder for writing an essay.

If the applicant passes these examinations satisfactorily he may begin at once the regular Freshman work; but if he is deficient in any one or more subjects he may enter conditionally and make up his deficiency as soon as possible in the Preparatory Department.

Credits from High Schools or preparatory schools in good standing will be accepted in place of examinations.

THE DEPARTMENT OF CIVIL ENGINEERING.

The courses of instruction are designed to prepare students for a thorough and systematic training in the sciences and in the principles of Civil Engineering, to perform intelligently the duties of their profession either in the office or in some of the responsible positions superintending the construction and operating of public works. To secure these results the student is given, not only a sound theoretical training in the courses of study but he is also required to study the practical applications of the principles upon which the theory is based. The first two years are devoted to the study of mathematics and the theoretical branches. The last two years are given to the study of applied courses—practical work in the laboratory and field, as much as possible, being required throughout the course.

Sufficient instruction is given in French and German to enable the student to read easily and intelligently professional work in these languages; while the study of English is pursued until the student is qualified to prepare acceptable themes on professional subjects. Instruction based upon standard text-books is given throughout the course by means of lectures, recitations, practice in laboratory, drawing-room and field. This work is largely supplemented by assigning to the student, for solution, practical problems bearing directly upon the subject matter discussed in the class room and requiring original investigation, thus training the student to habits of independence and awakening his interest in the work of his profession.

The Department is provided with all the instruments necessary for effective work in the different branches of

field engineering. After the student is taught the use and adjustment of the instruments, surveys, elementary in character, are commenced and continued progressively until the more difficult principles and methods are understood. In a similar manner is instruction given in the Courses in Sanitary Engineering, Hydromechanics, Resistance of Materials, Bridges and Roofs, etc., thus familiarizing the student with practical engineering subjects, and the most improved method of execution and designing.

A thesis on some approved subject connected with the course of study, is required of each student as a condition of graduation. The thesis must embody the results of original research.

(For equipment and facilities see pages 9-19.)

(For requirements of admission see pages 32, 33.)

STUDIES PRESCRIBED FOR THE DEGREE OF CIVIL ENGINEER.

FRESHMAN YEAR.

SUBJECTS FIRST TERM	Hrs. & Week	SEE FOR DESCRIPTION		SUBJECTS SECOND TERM	Hrs. & Week	SEE FOR DESCRIPTION	
		Page	Course			Page	Course
Algebra - -	5	47	I.	Anal. Geom.	5	47	II.
English - -	3	75	I.	English - -	3	75	I.
French - -	5	77	I.	French - -	5	77	I.
Chemistry -	3	67	II.	Chemistry -	3	67	II.
Drawing -	3	73	I., II.	Drawing -	1	73	II.
				Surveying -	5	50	II., III.

SOPHOMORE YEAR.

Calculus - -	5	48	III.	Calculus - -	5	48, 49	IV., V.
Des. Geometry	3	50	I.	Des. Geometry	3	50	I.
R.R. Survey'g	5	51	VI., VII.	Adv. Survey'g	5	51	IV., V.
Physics - -	5	65	II., III.	Physics - -	5	65	II., III.
Drawing -	1	73	V.	Drawing -	1	73	V.

JUNIOR YEAR.

Analytic				An. Mechanics	2	52	VIII
Mechanics -	5	52	VIII.	Mechanics of			
Geodesy - -	4	53	IX.	Materials -	3	53	X.
English - -	3	76	II.	Astronomy -	3	57	I.
Geology - -	2	71	I.	English - -	3	76	II.
Stereotomy -	3	74	VI.	Geology - -	5	72	III.
				Drawing - -	3	74	VII.

SENIOR YEAR.

Engineering -	5	54	XII.	Engineering -	5	54	XII.
Hydromechan	3	56	XVI.	Hydromechan	3	56	XVI.
Bridges, Roofs	5	55	X.	Graph. Stat.	5	56	XII.
Sanitary Eng.	2	55	XIII.	Sanitary Eng.	2	55	XIII.
Drawing - -	3	74	VII.	Roads, Pav'mt	4	54	XI.
				Thesis - - -			

THE DEPARTMENT OF MECHANICAL ENGINEERING.

The program of studies in Mechanical Engineering, leading to the degree of Mechanical Engineer, is open to young men who wish to prepare themselves for the designing of machinery, with its appurtenances, and for the successful management of power plants. As the program requires a thorough knowledge of pure and applied Mathematics, as well as of Physics, only those capable of adapting themselves to these requirements should take it up. The program of the department is modeled in the twofold belief that a thorough fundamental training is best secured by a study of the practical application of the principles involved, as well as of the theoretical principles.

The work of the department, conducted in connection with other departments elsewhere described, consists of the study, by text-book or lectures, of the materials used in mechanical engineering, accompanied by the science of pure mechanical kinematics, which traces the motions of connected parts without reference to the cause of such motions, to the work done or energy transmitted. This is succeeded by machine design, which is a direct development of kinematics, and the course continues throughout the Junior and Senior years.

The courses in Shopwork are most complete. The first year's work is confined to practice in the woodshop, in which the principles of carpentry, turning, and pattern-making are taught. When the students have become sufficiently skilled in woodwork, they take up the work of the foundry, blacksmith shop, and machine shop. A systematic course of training is provided, which advances

the student by easy steps until he has mastered all the details of the art.

The latter part of the Senior year is largely taken up in the preparation of a graduating thesis. Here especially the student is taught to depend as much as possible upon his own resources and abilities in exercising his ingenuity. This is the culminating effort of the program, embodying its chief results, and is expected to show considerable originality.

Every possible advantage is given the student wishing to specialize in some one of the branches of engineering, toward furthering his knowledge and ability in the particular field desired. He may take up general machine design, steam engine design, specifications and contracts, installation and erecting, original research or gas engine design and operation.

A systematic curriculum of study will be outlined in each individual case leading to a complete and proficient knowledge of the work undertaken.

Access may be had to all the machinery and apparatus of the University contained in the various power plants and laboratories elsewhere described, and every effort is made by the authorities to make the work as comprehensive as possible.

(For equipment and facilities see pages 9-19. For requirements for admission see pages 32, 33.)

STUDIES PRESCRIBED FOR THE DEGREE OF MECHANICAL ENGINEER.

FRESHMAN YEAR.

SUBJECTS FIRST TERM	Hrs a Week	SEE FOR DESCRIPTION		SUBJECTS SECOND TERM	Hrs. a Week	SEE FOR DESCRIPTION	
		Page	Course			Page	Course
Algebra - -	5	47	I	Analyt Geom	5	47	II
French - -	5	77	I	French - -	5	77	I
Drawing - -	3	73	I	Drawing - -	3	73	II
Chemistry - -	3	67	II	Chemistry - -	3	67	II
Shopwork - -	3	75	XIV a	Shopwork - -	3	75	XIV b

SOPHOMORE YEAR.

Calculus - -	5	48	III	Calculus - -	5	48,49	IV, V
Drawing - -	3	74	VIII	Drawing - -	3	74	VIII
Chemistry - -	4	67	IV	Chemistry - -	4	68	V
Physics - -	5	65	II, III	Physics - -	5	65	II, III
Shopwork - -	3	75	XIV c	Shopwork - -	3	75	XIV d

JUNIOR YEAR.

An. Mechanics	5	52	VIII	An. Mechanics	2	52	VIII
Kinematics -	5	60	V	Mech's of Mat	3	53	X
English - -	3	75	I	Mach'n Design	3	60	VI
Physics - -	3	66	IV	Valve Gears	2	60	VII
Shopwork - -	3	75	XIV e	English - -	3	75	I
				Drawing - -	3	73	IV
				Shopwork - -	3	75	XIV f

SENIOR YEAR.

Materials of Engineering	2	58	II	Steam Engine Design - -	5	59	III
Thermodyn	5	58	I	Steam Boilers	3	59	IV
Steam Engine Design -	5	59	III	Hydraulics -	5	61	IX
Mechan'l Lab	3	61	VIII	Thesis - - -			
Shopwork -	3	75	XIV f				

TWO-YEAR PROGRAM IN MECHANICAL ENGINEERING.

**Theory, Design, and Operation of Gas, Oil,
and Vapor Engines.**

This course is devoted exclusively to the study of explosive motors, and embraces it in theory, design, construction and operation.

The rapid progress made in recent years in the design of gas engines, together with their adaptation to the supplying of power for almost every requirement, has led to the establishment of this program for young men wishing to make a special study of this branch of engineering.

The essential work of the first year consists of a general descriptive study of the different types of engines with discussions on the general management, operation, care and special uses to which this type of motor may be applied. During the second year the general theory of the gas engine is studied and the design of an engine for a specific purpose is undertaken by each student.

The laboratory work will consist in part of indicator practice, determination of mechanical and thermodynamic efficiency, speed regulation, and economy. Experiments in flame, electric and hot tube ignition, operation of vaporizers and carburettors, construction of spark coils with management and care of motors will complete the work.

The courses in shopwork are intended to give practical application to the theories advanced in the class room by the complete building and testing of a gas engine of a design to be selected by the demonstrator. Each student is required to prepare the patterns and core-boxes, machine the castings and forgings, assemble the complete

engine and submit a comprehensive report of a test on the machine constructed. If the report proves satisfactory, a certificate of proficiency in the field is given to the student and the gas engine becomes his own property.

For admission to this course the student must certify by examination or certificate, his ability to pursue the studies of the first year. Candidates shall also write a short essay, which must be satisfactory in spelling, punctuation, sentence and paragraph construction.

(For equipment and facilities see pages 16-18.)

STUDIES PRESCRIBED FOR SHORT PROGRAM IN MECHANICAL ENGINEERING.

FIRST YEAR.

SUBJECTS FIRST TERM	Hrs. a Week	SEE FOR DESCRIPTION		SUBJECTS SECOND TERM	Hrs. a Week	SEE FOR DESCRIPTION	
		Page	Course			Page	Course
Algebra - - -	5	89	C	Mathematics -	5	90	F & G
Geometry - - -	5	89	E	Trigonometry	5	90	H
Drawing - - -	3	73	I	Drawing - - -	3	73	II
Shopwork - - -	3	75	XIV a	Shopwork - - -	3	75	XIV a
Chemistry - - -	4	66	I	Physics - - -	4	65	I
GasEngines -	5	62	XII	VaporEngines	5	62	XII

SECOND YEAR.

Motor Design	10	62	XIII	Motor Design	10	62	XIII
Shopwork - -	6	75	XIV g	Shopwork - -	6	75	XIVg
Laboratory - -	3	63	XIII	Laboratory - -	3	63	XIII
				Engines and Boilers - - -	3	61	X

DEPARTMENT OF ELECTRICAL ENGINEERING.

The remarkable development of electrical industries during the past few years has created a demand for men skilled in the theory and practice of electrical and mechanical work. The study of the subjects arranged on the following page is intended to give a general education as well as a special training in the technical branches involved in the various practical applications of electricity in industrial operations.

General theory is given in lectures and by recitations from standard text-books. In the laboratories and shops the operations explained in the class room are performed by the student, in doing which he acquires some skill in handling tools and instruments, and obtains a working knowledge of the principles involved. Careful records of the work done in laboratories are kept by the student and are handed in for suggestions and corrections at the end of every week.

The University is located near a great manufacturing center in the growth of which electricity is taking a very prominent part. Electric power generated by steam is now being distributed and utilized in several large plants, some using the three phase alternating system while others are using the direct current. One of the largest water power developments in the middle west is situated within a few miles of the University. From this establishment we receive three phase alternating currents which furnish light for our buildings and grounds, and power for driving motors in our shops and printing offices, etc., all of which are operated by electricity.

There are numerous other transmission lines and electrical power plants operated by water power within

a short distance. Our students visit all of these plants, accompanied by an instructor who points out the applications of the text-book theory in the design of electrical apparatus and its operation under actual working conditions.

(For requirements for admission, degree, etc., see pages 32-33.)

(For equipment see pages 9-19.)

Each candidate for graduation must present at the end of the Senior year an acceptable thesis embodying the results of an extended original research on an engineering subject, chosen at the beginning of the year, with the approval of the head of the department. The descriptive part must be typewritten on ledger paper, and bound in book form together with the drawings.

**Studies Prescribed for the Degree of Mechanical
Engineer in Electrical Engineering.**

FRESHMAN YEAR.

SUBJECTS FIRST TERM	Hrs. a Week	SEE FOR DESCRIPTION		SUBJECTS SECOND TERM	Hrs. a Week	SEE FOR DESCRIPTION	
		Page	Course			Page	Course
Algebra - - -	5	47	I	Analyt. Geom.	5	47	II
French - - -	5	77	I	French - - -	5	77	I
Drawing - - -	3	73	I	Drawing - - -	3	73	II
Chemistry - -	3	67	II	Chemistry - -	3	67	II
Shopwork - -	3	75	XIV a	Shopwork - -	3	75	XIV b

SOPHOMORE YEAR.

Calculus - - -	5	48	III	Calculus - - -	5	48	IV
Des. Geom. - -	4	73	III	Des. Geom. - -	4	73	III
Physics - - -	5	65	II, III	Physics - - -	5	65	II, III
Shopwork - -	3	75	XIV c	Shopwork - -	3	75	XIV d

JUNIOR YEAR.

Analytic Mechanics -	5	52	VIII	An. Mechanics	2	52	VIII
Kinematics - -	5	60	V	Mech's of Mat. Machine	3	53	IX
English - - -	3	75	I	Design - - -	5	60	VI VII
Physics - - -	3	66	IV	English - - -	3	75	I
Shopwork - -	3	75	XIV e	Physics - - -	3	66	IV
				Shopwork - -	3	75	XIV f

SENIOR YEAR.

Dynamo Machinery -	5	64	III	Dynamo Machinery -	5	64	III
Thermodyn'm	5	58	I	Electrical Lab	5	64	IV
Electrical Lab	5	64	IV	Designing - -	3	65	V
Designing - -	3	65	V	Hydraulics - -	5	61	I
Thesis - - -				Thesis - - -			

SHORT PROGRAM FOR APPLIED ELECTRICITY.

Students who do not wish to take the languages and higher mathematics required in the regular four-year program should take up this program, which may be completed in two years. The short program is arranged to give an accurate knowledge of the fundamental theories of electricity and magnetism, as well as a certain amount of skill in handling electrical machinery and appliances. Algebra, geometry, trigonometry, and elementary physics are included, for they are necessary in order to carry on successfully the practical work of designing, manufacturing and testing or operating electrical apparatus. Training in this practical work is given in the drafting room, the machine shops, and in the electrical and physical laboratories.

The actual conditions of the commercial application of electricity to the distribution of light and power are learned by testing, repairing and making additions to the University plant and by visiting the numerous electric establishments in the vicinity, accompanied by an instructor.

The study of the principles of mechanical drawing is taken up early in the course and sufficient practice is given to enable the student to make working drawings and to follow them in the construction of apparatus in the shops and laboratories.

Applicants for admission to the Short program should be at least 17 years of age. They should have a fair knowledge of the subjects taught in the common schools, especially arithmetic and algebra, as far as quadratics. They shall also write a short essay which must be satis-

factory in spelling, punctuation, sentence and paragraph structure.

When the required studies have been satisfactorily completed, a certificate stating that fact is issued.

The laboratory fees for students who are taking the regular work in this course, according to the following schedule, after they have finished all the work required for entrance, shall be as given on page 30.

All others are special students and for them the fee is as given on page 25 for Applied Electricity.

STUDIES PRESCRIBED FOR SHORT COURSE IN APPLIED ELECTRICITY.

FIRST YEAR.

SUBJECTS FIRST TERM	Hrs. a Week	SEE FOR DESCRIPTION		SUBJECTS SECOND TERM	Hrs. a Week	SEE FOR DESCRIPTION	
		Page	Course			Page	Course
Algebra - - -	5	89	C	Geometry - - -	5	89	D
Drawing - - -	3	73	I	Drawing - - -	3	73	II
Shopwork - - -	3	75	XIV a	Shopwork - - -	3	75	XIV b
Physics - - -	4	65	I	Physics - - -	4	65	I
Applied Electricity -	5	63	I	Applied Electricity -	5	63	I

SECOND YEAR.

Trigonometry	5	90	H	Engines and Boilers - - -	3	61	X
Designing - -	3	65	V	Designing - -	3	65	V
Shopwork - -	3	75	XIV c	Shopwork - -	3	75	XIV d
Dynamo				Dynamo			
Machinery -	5	64	III	Machinery -	5	64	III
Applied				Applied			
Electricity -	5	63	II	Electricity -	5	63	II

COURSES OF STUDY.

(In the description of courses a "term" means nearly five months.)

COURSES OF PURE MATHEMATICS.

I.

ALGEBRA—This course includes a study of the binomial theorem, the theory of logarithms, choice, chance, variables and limits, series, determinants. Then follows a thorough study of the general properties and solution of equations, embracing the subjects of derivatives, transformation, detached coefficients, surd and imaginary roots; incommensurable roots, limits of roots, biquadratic equations, Des Cartes' and Cardan's rules; Sturm's theorem; Horner's method; roots of complex number and trigonometric solution of cubic equations. Text-book, *Wentworth*.

[Five hours a week for one term.]

II.

ANALYTIC GEOMETRY—This course includes a study of the point and right line; conic sections, their equations and properties; discussion of the general equation of the second degree containing two variables; higher plane curves, equations of the third degree; different systems of coordinates; transformation of coordinates; spirals; an elementary course in geometry of three

dimensions, embracing the point, straight line, plane, and surfaces of revolution; transformation of coordinates; quadric surfaces and supplementary propositions. Text-books, *Bailey, Wood*.

[Five hours a week for one term.]

III.

CALCULUS DIFFERENTIAL — This course, as also Courses IV. and V., is designed to meet the requirements of engineering students. It includes a study by the methods for the differentiation of algebraic, logarithmic and exponential, trigonometric, and inverse trigonometric functions; successive differentiation and differential coefficients; treatment of implicit and compound functions; expansion of functions; indeterminate forms; partial differential coefficients of the first order and of higher orders; direction of curvature; radius of curvature; envelopes; singular points of curves, maxima and minima of functions of one independent variable, and of several independent variables; tracing curves, differentials of arcs, plane areas, surfaces and volumes of revolution. Text-book, *Osborne*.

[Five hours a week for one term.]

IV.

CALCULUS INTEGRAL — Integration of elementary forms and of rational fractions; integration by rationalization and by parts; successive integration; multiple integrals; definite integrals, limits of integration; double integration applied to plane areas; rectification of plane curves; quadratures of plane areas and surfaces of revolution; surface and volume of any solid; intrinsic equation of a curve. This course is supplemented by numerous exercises and examples. Text-book, *Osborne*.

[Five hours a week for three months.]

V.

DIFFERENTIAL EQUATIONS—An elementary course for engineering students, supplementary to the Course of Integral Calculus. It embraces: equation of the first order and first degree; equations of the first order but not of the first degree; singular solutions; linear equations with constant coefficients; special forms of equations with higher orders. Numerous applications to Mechanics and Physics are introduced during the course. Text-book, *Murray*.

[Five hours a week for six weeks.]

VI.

ELECTIVE WORK—The prescribed Courses in Pure Mathematics are I. to V. inclusive. The following advanced courses are offered, based on standard authors. The text-books are not necessarily the same every year. The number of students required to constitute a class in any one subject must be at least five.

- (a) Higher Algebra, *Hall and Knight, Smith, Crystal*.
- (b) Advanced work in Trigonometry, *Todhunter, Lock*.
- (c) Determinants, *Peck, Hanus, Muir*. (d) Theory of Equations, *Burnside and Panton*. (e) Advanced Calculus, *Byerly, Todhunter, Williamson*. (f) Advanced Analytic Geometry, *Salmon*. (g) Analytic Geometry of Three Dimensions, *Aldis, Frost, Salmon*. (h) Quaternions, *Hardy* with *Kelland and Tait* as reference.

[Three hours' recitation a week for one subject.]

COURSES IN CIVIL ENGINEERING.

I.

DESCRIPTIVE GEOMETRY—In this course are considered problems on the point, right line, and plane; single curved, double curved, and warped surfaces; problems relating to tangent planes to single curved, double curved, and warped surfaces; intersection of surfaces by planes, tangencies, development of surfaces; spherical projections; orthographic, stereographic, globular, cylindrical, and conic projections; construction of maps, shades and shadows; linear perspective; isometric projections; theory and plates. Numerous practical problems and exercises requiring the application of the principles of Descriptive Geometry, are added by the instructor. Text-book, *Church*.

[Three hours a week for two terms.]

II.

SURVEYING—This course comprises the whole theory of land surveying and leveling; the use and adjustment of the transit, compass, level, and plane table; methods of measuring; relocations of boundaries; supplying omissions; obstacles to measurement; computations; field notes and plots; laying out land; parting off land; dividing up land; Public Lands survey. Text-book, *Gillespie*.

[Five hours a week for one term.]

III.

SURVEYING—Field practice and application of theory; adjustment and use of instruments in the field; solution

of problems in the field, the theory of which is taught in the class room ; practice in keeping field notes ; computation and plots.

[Four hours a week for six weeks.]

IV.

HIGHER SURVEYING — This course is a more complete treatment of the theory of Surveying than Course II. and cannot be taken until the completion of that course. It treats of the adjustment, use, and care of all kinds of engineering instruments ; problems pertaining to solar attachment ; topographical surveying with the transit and stadia ; mining surveying ; mining claims ; survey of mines with shafts and drifts ; determining positions of ends of tunnels, and depths below surface ; theory of hydrographic and city surveying ; geodetic surveying and leveling ; measuring base lines ; adjustments of angles, triangles, and quadrilaterals ; latitude and azimuth ; time and longitude ; changing mean time into sidereal time and sidereal time to mean time. Text-book, *Johnson*.

[Five hours a week for one term.]

V.

SURVEYING — Exercises in the field in the adjustment and use of engineering instruments ; stadia and plane table surveying in the field, leveling ; practice in hydrographic surveying.

[Four hours a week for six weeks.]

VI.

RAILROAD SURVEYING — This course comprises all the theory pertaining to reconnoissance and preliminary surveying for a railroad ; theory and maximum economy in grades and curves ; location of curves by deflection angles and offsets ; obstacles to location of curves ; special

problems in curves; theory of compound curves; turn-outs and crossings; curving the rail on curves and elevation of outer rail; easing grades on curves; vertical curves; earthwork and prismoidal formula; theory of excavation and embankment; correction in excavation on curves; cross-section leveling. Theory of the transition curve and practical applications. Text-books, *Searle, Crandall*.

[Five hours a week for one term.]

VII.

RAILROAD SURVEYING — Exercises in the field; staking out and running tangents, simple, compound and transition curves; execution on the ground of many problems previously treated theoretically; survey for a short line of railroad, leveling, cross-section work, and setting slope stakes; making profiles and maps; calculating the necessary excavations and embankments and cost of construction; culverts.

[Four hours a week for six weeks.]

VIII.

ANALYTIC MECHANICS — The aim of this course is to prepare students of engineering for the study of the courses of applied Mechanics. The course comprises a study of the fundamental principles of statics, kinematics, and kinetics. The subjects selected are studied with the object of thoroughly preparing the engineering students to pursue the technical and practical branches of their respective courses. Some of the topics considered in this course are: work, energy, conservation of energy; power, composition and resolution of forces, center of gravity, center of mass, moment of inertia, acceleration, dynamics of rigid bodies, laws of friction, etc. Text-book, *Ziwet*.

[Five hours a week for first term. Two hours a week for second term.]

IX.

GEODESY—This is an elementary course prescribed for Civil Engineering students in the Junior year, and comprises a study of the instruments and methods of observation, base measurements and field work of the triangulation; method of least squares, elementary course; calculation of the triangulation, and theory of probable errors; geodetic latitudes, longitudes, and azimuths. This is followed by a brief discussion of the figure of the earth. Text-book, *Merriman*

[Four hours a week for one term.]

X.

MECHANICS OF MATERIALS—This course is intended to meet the requirements of engineering students, and to prepare them, by a study of the action and effect of forces on beams and structures, to design, economically and intelligently the parts entering into a complete structure. The course comprises a study of the elastic and ultimate strength and ultimate deformation of the materials of engineering, their properties and methods of testing, and discussion of cases of simple stresses. The general theory of beams including cases of simple and cantilever beams, overhanging, fixed, and continuous beams, is thoroughly investigated. Columns are examined according to Euler's, Rankine's, and other formulae, and results compared. Some of the other subjects considered in this course, are torsion of shafts, the transmission of power by shafts, apparent combined stresses, such as flexure and compression, flexure and torsion, etc. Compound columns and beams, reinforced concrete beams, plate girders and other forms. Then is studied the subjects, resilience and work, impact and fatigue, true internal stresses, centrifugal tension and

flexure, unsymmetric loads on beams,—the course closing with a study of the mathematical theory of elasticity. Text-book, *Merriman*.

[Three hours a week for one term.]

XI.

ROADS AND PAVEMENTS—This course is intended to familiarize the student with the practical details of laying out and constructing highways, the method of drainage, grading, and most suitable road covering, the improvement of streets in cities and materials used for paving and covering. The manner of preparing the street before the paving is placed in position is fully considered and illustrated. The course includes a thorough discussion of the theory of pavements and a description of the various materials used such as cobble and stone-block, asphalt, brick, wood, and broken stone pavements. The method of preparing plans and specifications for the various conditions arising are considered and original plans are prepared by students. Attention is also given to the construction of street-car tracks in paved streets. Text-book, *Baker*.

[Four hours a week for one term.]

XII.

ENGINEERING—This course is taken by students of Civil Engineering in the Senior Year and teaches the best approved methods of constructing engineering works and the styles of structures suitable for different localities. The study is quite comprehensive including the general theory of the arch and application to the vousoir arch; the theory of earth pressure, and the design of retaining walls; foundations suitable for structures of various classes in connection with which the student becomes acquainted, not only with the methods

for ascertaining the bearing power of the foundation, but also the means for constructing deep foundations. The methods for tunnel construction, sewer construction, irrigating canals, river improvements, are included in the course and given by text-book and lectures. The part pertaining to masonry construction includes a study of the properties of stone, brick, mortar, the manner of testing, foundations under water, the crib and open caisson process, the pneumatic process, the theory of masonry arches and design, arch centers, selection of site for bridge piers and arrangement of spans, the details of construction of bridge piers and manner of location, specifications for masonry, etc. Text-books, *Howe, Patton, Baker, Rankin.*

[Five hours a week for two terms.]

XIII.

SANITARY ENGINEERING—This course is a study of the principles and methods of drainage and disposal of sewage in populous districts; shape, material and calculation of sewers; catchbasins, flushing and ventilation; separate and combined systems compared; pollution of rivers; chemical precipitation; results and costs of purification; general municipal and domestic sanitation; inspection of neighboring works. Text-book, *Staley and Pierson.*

[Two hours a week for two terms.]

XIV.

BRIDGES AND ROOFS—This course comprises a study of the different systems of trussed bridges and roof trusses, and the calculation of the strains produced when loaded in any manner, the weight of the structure and the effect of wind included. Both graphical and analytical methods are used. Besides the various systems of

trussed bridges, which are studied in detail, the plate girders, suspension bridges, cantilever bridges, draw bridges, and roofs of various designs are given equal attention; the purpose being to familiarize the student with the different forms and enable him to design and to estimate the cost of construction. Text-book, *Merriman*.

[Five hours a week for one term.]

XV.

GRAPHICAL STATICS — This course teaches the determination of stresses in framed structures by the graphical method. Shearing forces, bending moments, centres of gravity, and moments of inertia are graphically determined by the application of the principles of the force and equilibrium polygons; also the determination of stresses in bridge trusses with parallel chords and with broken chords, caused by uniform loads and locomotive-wheel loads; graphical determination of stresses in roof trusses, graphical treatment of the arch, symmetrical and unsymmetrical cases; graphical method of arch-ribs of hinged ends, and of fixed ends; stress diagrams; temperature stresses; braced arches; graphics applied to continuous girders. This course is supplemented by full explanations, notes, examples, and problems. Text-book, *Merriman*.

[Five hours a week for one term.]

XVI.

HYDROMECHANICS — This course is a thorough study of the theory of hydrostatics, hydraulics, and hydrodynamics, to which are added many practical exercises. The subjects submitted are the transmission of pressures, center of pressures; velocity of flow from orifices of various shapes; fluid friction; Bernaulli's theorem with friction; Chezy's formula; Kutter's formula; flow over

weirs, and through tubes; flow in pipes; loss of head in in friction and other losses; flow in conduits, canals, and rivers; velocities in cross sections; methods of gauging the flow, measurement of water power, dynamic pressure of flowing water; designing of waterworks and standpipes; hydraulic motors and relative merits; discussion of water wheels of different types, and a study of the conditions determining high efficiencies; classification of turbines, and a complete study and discussion of the different forms. Text-book, *Merriman*.

[Three hours a week for two terms.]

COURSE IN ASTRONOMY.

ASTRONOMY — Practical. This course is designed to meet the requirements of Civil Engineering students and to give them the training and information necessary for intelligently executing certain departments of work to which they may be assigned in the course of their professional career. The course comprises a study of astronomical instruments as well as instruments of more precision than those used in ordinary surveying. The adjustment and use of these instruments are considered, and instruction is given in methods of observation and computations; problems in finding right ascensions and declination; different methods for finding latitude, longitude and time are studied in detail, and the methods of making the observations and their adjustments, and discussion of errors. Conversion of solar time into sidereal, and sidereal time into solar. In connection with this subject is given a more complete study of many of the topics considered in elementary astronomy, as here they are treated mathematically; as for example, methods for

finding parallax, computation of eclipses, altitudes and correction for refraction. The subjects of procession,— nutation—annual aberration—proper motion of stars, etc., are studied. Text-book, *Young, Greene*.

[Three hours a week for one term.]

COURSES IN MECHANICAL ENGINEERING.

I.

THERMODYNAMICS—The subject begins with a theoretical study of the steam engine, gas engine and other heat motors involving the laws of thermodynamics of gases, saturated vapors and superheated steam. The applications of this preliminary work are then dwelt upon, and prime movers, the injector, condenser, refrigerating machinery, boilers and pumps are studied in detail. Frequent reference is made to trade catalogues, of which an abundant supply should be obtained by the student. Text-book, *The Steam Engine*, by Holmes.

[Five hours a week for one term.]

II.

MATERIALS OF ENGINEERING—This course, supplemented by shopwork and laboratory work in testing materials of construction, is designed with the purpose of acquainting the student with the properties of the material he will use in his profession. Tensile and shearing strength, elasticity and resistance are studied, together with the effects of strain, intermittent loading and impact. The process of manufacture of the most important materials is taken up and estimates of the cost

of construction at market prices complete the work. Thurston's *Materials of Engineering* is the text-book used.

[Two hours a week for one term.]

III.

STEAM ENGINE DESIGN—In this course the forms and sizes of steam engines, computation of dimensions and advantages and adaptation of special forms of engines for specific work are taken up, which give the student a thorough knowledge of constructive detail. The latest researches and contemporary practice may be consulted in the numerous publications found in the University Library. During the first term of the Senior Year is required the complete design with working drawings of a simple non-condensing steam engine for a specific purpose. The second term is given to designing a multiple expansion, jacketed, condensing engine for marine service. The text-book used is Whitham's *Steam Engine Design*.

[Five hours a week for one term.]

IV.

STEAM BOILERS—This subject is treated much as that of Steam Engine. The determination of sizes of parts from considerations of strains, thickness of shells, size of rivets, braces, furnaces and proper methods of connection of boilers with efficiency of furnaces and life of boiler, are some of the subjects considered. The method of determining the efficiency of fuels, heating surface, heights of chimneys, boiler settings and materials used in construction are also discussed. Text-book, *Steam Boilers* by Munro.

[Three hours a week for one term.]

V.

KINEMATICS—This course treats of the geometry of machinery, the determination of the paths of the various parts of an elementary combination and the constraining of the parts to move in these paths. The general theory is then applied to cams and gear teeth, the relative motion of machine parts and kinematic trains, belts, pulleys, speed cones, link work and other aggregate combinations. Barr's *Kinematics of Machinery* is the text-book used.

[Three hours recitation and two hours drawing a week for one term.]

VI.

MACHINE DESIGN—This work involves a study of the form and strength of machine parts as applied in designing with computation of dimensions for fastenings; bearings, rotating pieces, belt and tooth gearing, etc. The derivation of rational formulæ and the determination of empirical formulæ are included and applied in designing. The text-books used are Unwin's *Elements of Machine Design*, Low's *Handbook for Mechanical Engineers* and Reed's *Machine Design and Drawing*.

[Three hours a week for one term.]

VII.

VALVE GEARS—This course includes a complete study of the Bilgram diagram as applied to slide valves and the principal automatic cut-off engines. The radical gears, such as Hackworth, Walschært, Marshall and Joy are treated in the same way and in conclusion the student is made familiar with the various types of Corliss valves, shifting eccentrics and link motions. The text-book is Halsey's *Valve Gears*.

[Two hours a week for one term.]

VIII.

MECHANICAL LABORATORY—The work taken up includes a study of the methods of testing the steam engine under varying running conditions, valve setting, calibration of thermometers, gauges and indicator springs, use of Prony brake, Weber and Emerson dynamometers, Pelton water wheel, Wier calibration, etc. Text-book, Carpenter's *Experimental Engineering*.

[One afternoon each week for one term.]

IX.

HYDRAULICS—The object of this course is to give such information in regard to modern turbines and their installation as is necessary to the hydraulic engineer in designing a water power plant without going into the details of turbine wheel designing. Text-book, Thurso's *Modern Turbine Practice*. (*Required of Seniors in Mechanical and Electrical Engineering*.)

[Five hours a week for one term.]

X.

STEAM ENGINES AND BOILERS—A briefer course in the study of boilers and steam engines designed to familiarize the student with the different types in use and their respective merits. Only that theory is taken up which is necessary to the working out of practical problems, the ultimate object of the course.

Students taking this work must provide themselves with an abundant supply of trade catalogues. Text-book, *Power and Power Transmission*, by Kerr.

[Three hours a week for one term.]

XI.

THESIS—Each candidate for a degree in this department must present for graduation a thesis of considera-

ble magnitude which will exhibit his knowledge of the course he has followed. It may embrace designing, experimental investigation or original research in a subject selected by the student and approved by the Professor. The major part of the second term, Senior Year, is devoted to this work, and graduation is conditional upon the knowledge of Mechanical Engineering displayed in its preparation.

[Twelve hours a week for one term.]

XII.

GAS ENGINES—This course, extending over two terms, is given to a general descriptive study of all the types of gas engines and explosive motors. The general construction of gas, oil and vapor engines is studied together with their adaptation to various uses. Results due to change in ignition, compression and variation of working fluid; methods of speed regulating and governing and the details of auxiliaries as, pumps, carburetters, hot tubes, batteries, spark coils and dynamos are dwelt upon. The text-book used is *Gas, Oil and Vapor Engines*, by Hiscox.

[Five hours a week for two terms.]

XIII.

GAS ENGINE DESIGN — A complete study of the thermodynamics and design of the gas engine, by text-book, lectures and drawing board. The major subjects taken up are power, efficiency, economy, forces due to gas pressure and inertia and dimensions of engine parts. Lucke's *Gas Engine Design* is the text-book used.

[Five hours recitation and ten hours drawing
per week for two terms.]

XIV.

GAS ENGINE CONSTRUCTION—The complete working up from rough castings and forgings of a small type of

gas engine. This is part of the thesis work and requires the complete machining and assembling of the engine. Must be preceded by Courses XII. and XIII.

[Three hours a week for two terms.]

XV.

GAS ENGINE LABORATORY—Indicator practice, commercial efficiency, governing, economy, speed regulation. Experiments in ignition, spark coil construction, carburetters and vaporizers. Test of engine constructed by student.

[Two afternoons each week for two terms.]

COURSES IN ELECTRICAL ENGINEERING.

I.

APPLIED ELECTRICITY—A course of lectures and recitations, supplemented by laboratory practice, on the general theory of electricity and magnetism and its application to practical work, as follows: Setting up and testing primary and secondary batteries, systems of call bells, electric and gas lighting appliances, fire and burglar alarms, telegraph and telephone lines, switchboards and accessories. Experiments with induction coils, magnets, switches, voltmeters, ammeters, wheatstone bridges, galvanometers and other measuring instruments. The study of direct current generators and motors, arc and incandescent lighting systems, street railway machinery and appliances, electric heating and forging, electrolytic processes, etc. Text-book, *Swoope, Practical Electricity*.

[Five hours a week for two terms.]

II.

APPLIED ELECTRICITY—Lectures and laboratory work on the construction and testing of switches, magnets,

measuring instruments, induction coils, etc. The calculation of sizes of wire and location of circuits for lighting and power, the experimental study of alternating current machinery and accessories.

If the student has acquired sufficient skill in handling tools in his workshop, he may design and build a small dynamo, starting with rough castings, doing all the fitting and finishing, winding and adjusting, and finally testing for insulation, efficiency, and adaptability to special purposes. This Course must be preceded by Course I. (*Courses, I. and II., are required in the Short Program in Electrical Engineering; they are elective for general students and those studying telegraphy.*)

[Five hours a week for two terms.]

III.

DYNAMO-ELECTRIC MACHINERY—Recitations on the physical theory of dynamo machines, armature actions and reactions, characteristic curves, mechanical points, theory of armature winding, the mathematical theory of alternating currents, phase relations, modern forms of single phase and multiphase generators and motors, design of transformers. Text-books, *Sheldon, Dynamo Electric Machines, Sheldon and Mason, Alternating Currents.*

[Five hours a week for two terms.]

IV.

ELECTRICAL LABORATORY—Practical work at wiring buildings for lights and power, testing circuits for insulation and grounds, construction and operation of storage batteries, management and care of dynamos, characteristic curves of particular machines under different conditions, efficiency tests of motors by absorption dynamometer methods, alternating current dynamo and

transformer tests, the testing of storage batteries, and complete plant-efficiency tests. Careful notes are taken.

[Five hours a week for two terms.]

V.

DESIGNING—The designing and making of working drawings of switches, resistance, and other electrical apparatus. Calculation of sizes of wire and location of circuits for lighting buildings. Complete drawings of direct and alternating current dynamos. Laying out plants for power and lighting.

[Three hours a week for two terms.]

COURSES IN PHYSICS.

I.

PHYSICS—A complete course of recitations and lectures, including mechanics, heat sound, light, electricity, and magnetism. The work is fully illustrated by experiments. Text-book, *Carhart* and *Chute*.

[Five hours a week for two terms.]

II.

GENERAL PHYSICS—In this course there is a more extended treatment of the same subjects than is given in Course I. Mathematical principles are applied to physical phenomena. Special attention is paid to accuracy in the mathematical work and in the statements of the principles involved. Lectures and recitations. Text-book, *Hastings and Beach*.

[Three hours a week for two terms.]

III.

PHYSICAL PROBLEMS—The application of mathematics in physical work. Measurements of length, mass and

time. Work in mechanics, heat, light, sound, electricity and magnetism. The work is done in the laboratory and the student is taught to depend on his own resources and to check his results.

[Two hours a week for two terms.]

IV.

PHYSICAL LABORATORY—Special advanced work in heat, light, mechanics, sound, electricity, and magnetism. Accuracy in observations and in the calculation and recording of the results is required. Students may specialize here according to the program which they are following. This course must be preceded by Courses II. and III.

[Three hours a week for two terms.]

(For list of apparatus see pages 10-14.)

COURSES IN CHEMISTRY.

(In the description of these courses, an "hour" means two sixty-minute periods in the laboratory or one in the lecture room.)

I.

(a) GENERAL CHEMISTRY—A minor Course dealing with the general principles of the science and embracing a study of only the commoner elements and their typical compounds. Text-book, *Remsen's Elements of Chemistry*.

[Four hours a week for one term.]

(b) A LABORATORY COURSE covering in the laboratory the work of the Lecture Course (I. a) and designed to accompany it. *Laboratory Manual, Maguire*.

[One hour a week for one term.]

II.

(a) GENERAL DESCRIPTIVE CHEMISTRY—Recitations and experimental lectures treating of the fundamental principles of chemistry, and designed to meet the requirements of the students of the Engineering department. Text-book, *Hessler and Smith*.

[Two hours a week for two terms.]

(b) A LABORATORY COURSE arranged to fit the needs of Engineering students.

[One hour a week for two terms.]

III.

(a) ADVANCED INORGANIC CHEMISTRY—For Biological, General Science and Chemistry students. Lectures and recitations. A complete study of the elements and their most important compounds, following the classification based on Mendeleeff's Law, and including a discussion of the theories of the science. Careful attention is given to the technical chemical processes and industries, and to the writing of chemical reactions. Text-book, *Newth's Inorganic Chemistry*.

[Two hours a week for two terms.]

(b) EXPERIMENTAL CHEMISTRY—A Laboratory course to accompany Course III. (a), the work consisting of the preparation by the student, of the elements and their more typical compounds, determination of molecular weights, verification of the fundamental laws of chemistry, etc. During the latter part of the course, special attention is given to the characteristic reactions of the metals and to the principles of chemical analysis. Text-book, *Thorp*.

[Two hours a week, with discussion, for two terms.]

IV.

QUALITATIVE ANALYSIS—The work of this course comprises, in the laboratory, the study of the reactions

involved in the separation and detection of the more common inorganic bases and acids, the analysis of salts, mixtures of salts, and complex substances such as earths, ores, ashes, etc. Text-book, *Perkin*, supplemented by lectures.

[Four hours a week, with recitation, for one term.]

V.

QUANTITATIVE ANALYSIS—A laboratory study of the principles involved in the quantitative separation and estimation of substances, both gravimetrically, and volumetrically. Complete analysis of a number of simple salts, like Barium Chloride, with partial analysis of substances such as steel, lye, drinking-water, etc. Text-books, *Appleton*, *Schimpf*.

[Four hours a week, with recitation, for one term.]

VI.

(a) ELEMENTARY ORGANIC CHEMISTRY—Lectures and recitations. A systematic study of the hydrocarbons and their derivatives, and the investigation of their properties. Special attention is given to the Aliphatic and Aromatic series. Text-book, *Remsen*.

[Five hours a week for one term.]

(b) EXPERIMENTAL ORGANIC CHEMISTRY—A course fitted to accompany the preceding, involving the preparation by the student in the laboratory of the most important and typical organic compounds and the investigation of their properties. Text-book, *Gattermann*.

[Two hours a week for one term.]

VII.

URINARY ANALYSIS AND TOXICOLOGY—A course of laboratory exercises in the methods employed in the

detection and estimation of the constituents of the urine, and of the alkaloids and principal organic poisons. Text-book, *Holland*.

[Three hours a week for one term.]

VIII.

TECHNICAL CHEMICAL ANALYSIS—Advanced courses intended for students specializing in Chemistry. Special courses, at the option of the student in

- I. GAS ANALYSIS.
- II. WATER ANALYSIS.
- III. SUGAR ANALYSIS.
- IV. COMMERCIAL ORGANIC ANALYSIS.
- V. OILS AND FATS.

[Five to fifteen hours a week for two terms.]

IX.

(a) ADVANCED ORGANIC CHEMISTRY—An advanced course, intended for students specializing in chemistry. Lectures and recitations and discussion of special subjects of organic chemistry, synthetic chemistry, isomerism, and stereochemistry. Special reference works.

[Two hours a week for one term.]

(b) ADVANCED ORGANIC LABORATORY—(1) The first part of this course is spent principally in the making of organic preparations by methods demanding special care, skill and accuracy in the student. (2) The second term is devoted to ultimate organic analysis, qualitative and quantitative. Analysis of carbon, hydrogen, the halogens, sulphur and nitrogen in organic compounds by the various methods, also in the determination of molecular weights of organic compounds. Special Notes and reference works.

[Ten to fifteen hours a week for two terms.]

X.

GENERAL PHARMACEUTICAL CHEMISTRY—In this course, the chemical bases and their compounds are considered, with special reference to their importance in Pharmacy and Materia Medica. Text-book, Sadtler's and Trimble's *Pharmaceutical Chemistry*.

[Five hours a week for one term.]

XI.

(a) ELECTROCHEMISTRY—Lectures, experiments and recitations on the principles of electrochemistry and their application in the chemical industries and separation of metals and the preparation of chemical elements and electrosynthesis of compounds. Text-books, *Classen* and *Lüpke*.

[Five hours a week for one term.]

(b) ELECTROCHEMICAL LABORATORY—A laboratory course accompanying Course XI. (a). Experiments demonstrating the laws and principles of electrochemistry, electrolysis, electrosynthesis and electrometallurgy. Quantitative determination of metals electrolytically. Text-books, *Lüpke* and *Classen*.

[Two hours a week for one term.]

XII.

HISTORY OF CHEMISTRY—The subject is divided into topics and epochs of special interest in the development of chemistry as a science. These are discussed at length, together with the biographies of the men who aided in their development. Lectures and recitations. Seminar and journal work for advanced students. Text-book, *Meyer*. References to chemical periodicals.

[Three hours a week for one term.]

XIII.

(a) PHYSICAL CHEMISTRY—Lectures, recitations and demonstrative experiments on the subjects of gas density, solutions, chemical dynamics, the Phase Rule, thermochemistry, photochemistry, etc. Text-book, *Van Deventer*.

[Two hours a week for one term.]

(b) EXPERIMENTAL PHYSICAL CHEMISTRY—Laboratory work to accompany XIII. (a). Vapor density methods, calorimetric demonstrations, molecular weight demonstrations by the freezing and boiling point methods, etc.

[One hour a week for one term.]

XIV.

INDUSTRIAL CHEMISTRY—Lectures, recitations and laboratory work. The consideration of chemical manufacture, fuels, etc., and the preparation in the laboratory of chemically pure substances, organic and inorganic. Special reference books and journals.

[Five hours a week for two terms.]

XV.

ADVANCED QUANTITATIVE—Mostly laboratory work in special methods for gravimetric and volumetric determinations of inorganic substances. Special reference work.

[Five hours a week for one term.]

COURSES IN GEOLOGY.

I.

MINERALOGY—Lectures, recitations, and laboratory work. A study of crystallography and the classification of minerals, accompanied by practice in the laboratory

and museum in the determination of minerals, especially the ores. Blow-pipe analysis. Text-book, *Crosby*.

[Two hours a week for one term.]

II.

ASSAYING — Chiefly laboratory work. Furnace assaying of the ores of gold, silver and lead. Text-book, *Ricketts*.

[Two laboratory hours a week for one term.]

III.

GEOLOGY — Lectures recitations, demonstrations. The study of the general features of the earth. The material composing the accessible parts of the earth. The arrangements of the material in rocks. The causes of geological changes. The history of the earth and the various forms of life that existed in the different periods of successive geological ages. Text-book, *Brigham*.

[Five hours a week for one term.]

COURSES IN MECHANICAL DRAWING.

The instruction begins with sketching from blocks, of various geometric forms, so that the hand and eye may be trained in Outline Drawing in pencil and pen. Then follows the study of light and shade.

After considerable practice, and when a thorough knowledge of freehand drawing has been acquired, the use of instruments is taken up. Beginning with the instruments, attention is given to accurate draughtmanship upon plates, illustrating problems of Civil, Electrical and Mechanical Engineering. This work is continued throughout the Courses.

[Two hours of actual time in drawing are required for each hour on the schedule.]

I.

FREEHAND—This course consists of sketching with pencil and pen from flat copies and models of machine parts, and freehand lettering. Later in the term, the use of instruments, section-lining and lettering are taught. Text-book, *Jamison Elements*.

[Three hours a week for one term.]

II.

PROJECTION DRAWING—The course embraces the principles of projections, methods of shop-drawing, tinting, tracing, blue printing, line-shading and the preparation of working drawings of complete machines. This Course must be preceded by Course I. Text-book, *Jamison Manual*.

[Three hours a week for one term.]

III.

DESCRIPTIVE GEOMETRY—A series of accurate plates are made, illustrating the principles of orthographic and spherical projections, shades and shadows, perspective and isometric projections. (*Students in Architecture are required to do advanced work in shades and shadows and perspective.*)

[Four hours a week for two terms.]

IV.

KINEMATIC DRAWING—Designing of cams and gear teeth, complete working drawings of machines involving the application of kinematics and the computation of dimensions.

[Two hours a week for two terms.]

V.

TOPOGRAPHY—Pen and colored topographical drawing, conventional signs, map drawing from notes taken

from surveys. This course must be preceded by Course I. Text-book, *Reed*.

[One hour a week for two terms.]

VI.

STEREOTOMY—This course comprises a study of the application of the principles of Descriptive Geometry to the determination of the forms and sizes of the stones used in the construction of the different classes of arches and masonry structures. This course is given by lectures in the Drawing Room, explaining the construction of templates, and use of directing instrument; also explanations of methods of drawing plans, elevation and development of oblique arches, wing walls and the like. A certain number of plates and drawings is required, illustrating the methods of performing practical work.

Drawing and designing plans, elevations and sections of masonry constructions, foundations, dams, piers, abutments, culverts and arches. Text-book, *French*.

[Three hours a week for one term.]

VII.

BRIDGE DESIGNING—Proceeding from simple framed girders to complete bridge-trusses of various designs, required of Juniors in Civil Engineering. Complete design of a railroad bridge and detail drawings. A short general course of bridge designing for Seniors.

[Three hours a week for two terms.]

VIII.

MECHANICAL DRAWING—A continuation of Courses I. and II. embracing advanced work in machine drawing and the elementary principles of mechanical design with calculation of dimensions and construction of drawings from sketch-book notes. Text-book, Low's *Machine Drawing and Design*.

[Three hours a week for two terms.]

COURSES IN SHOPWORK.

(In the description of the following courses an "hour" means two sixty minute periods in the shop.)

(a) WOODWORK — Exercises in planing, splicing framing, scroll-sawing and turning.

[Three hours a week for one term.]

(b) APPLICATIONS OF CARPENTRY to pattern-making, cores, etc., including parts of machines, pipe joints, cranks and bearings.

[Three hours a week for one term.]

(c) FOUNDRY PRACTICE—Setting up and drawing simple and complicated patterns. Lectures on heating and pouring metals for different purposes. Core making.

[Three hours a week for one term.]

(d) IRON FORGING, welding, annealing; shaping, tool making, tempering and case hardening.

[Three hours a week for one term.]

(e) BENCHWORK in iron, including surface-chipping, key-setting, draw-filing, scraping and polishing.

[Three hours a week for one term.]

(f) ACCURATE WORK on lathe, planer, shafting and milling machines. Construction of machine tools, reamers, taps, twist-drills, gear wheels and complete machines.

[Three hours a week for two terms.]

COURSES IN ENGLISH.

I.

(a) PROSE FORMS—Special treatment of Exposition and Argumentation. Genung's *Working Principles of*

Rhetoric, Part II., and Heydrick's *How to Study Literature*.

[Two hours a week for one term.]

(b) LITERATURE AMERICAN—*Higginson and Boynton's*.

[Two hours a week for one term.]

(c) LYRIC POETRY.

[One hour a week for two terms.]

II.

(a) PROSE FORMS—Special study of the Novel and the Short Story.

[Two hours a week for one term.]

(b) LITERATURE—The Development of English Literature.

[Two hours a week for one term.]

(c) THE SONNET.

[One hour a week for two terms.]

COURSES IN GERMAN.

I.

Grammar, *Joyes-Meissner*, Part I. Translation from German into English of simple prose; translation of English exercises into German. Reading of short stories and selections from more difficult prose.

German Reader, *Miller and Wenkelbach*.

[Five hours a week for two terms.]

II.

Grammar, *Joyes-Meissner*, Part II; Translation into German of narrative prose and selections from history. Rapid reading of selections from history.

Herman and Dorethea (*Goethe*); Lichtenstein (*Hauff*).

[Three hours a week for two terms.]

III.

Grammar, *Joynes-Meissner*, Part III. Rapid reading of plays, poems and prose writings. Translations of selections from history and literature; original essays.

Minna von Barnhelm (*Lessing*); Best known poems, (*Heine*); Correspondence (*Schiller-Goethe*).

[Two hours a week for two terms.]

COURSES IN FRENCH.

I.

Grammar with written and oral exercises; the inflection of nouns and adjectives, the use of all the pronouns, the conjugation of regular and the common irregular verbs; the correct use of moods and tenses, the essentials of French syntax, and the common idiomatic phrases. Reading three of the following works: Houghton's *French by Reading*. *La Tâche du Petit Pierre*. (*Mairet*). *Un Cas de Conscience*. (*Gervais*). *La Main Malheureuse*. (*Guerber*). *Sans Famille*. (*Malot*). *Super's Readings from French History*.

[Five hours a week for two terms.]

II.

Advanced grammar with composition, study of idioms, memorizing. Dictations and conversations on practical topics, and careful reading of three or four of the following works: *Le Voyage de M. Perrichon*; (*Labiche*). *Roman d'un Jeune Homme Pauvre*. (*Feuillet*). *Fables choisies*. (*La Fontaine*). *Le Médecin Malgré Lui*. (*Molière*). *Le Cid*. (*Corneille*). *Esther*. (*Racine*). *Pages oubliées de* (*Chateaubriand*). *La Question d'Argent*. (*Dumas*). *Standard French Authors*. (*Guerlac*).

[Three hours a week for two terms.]

III.

The study in this course is devoted chiefly to the prose and poetry of the nineteenth century and includes composition, conversation, history and general view of French literature. Besides a translation and criticism of the best writers such as; *Causeries du Lundi*. (*Ste. Beuve*). *On Rend l' Argent* (*Coppée*). *Hernani*. (*Hugo*). *Méditations* (*Lamartine*). *Athalie*. (*Racine*). *L'Avare*. (*Molière*). *Mlle. de la Seiglière*. (*Sandeau*). *Les Origines de la France Contemporaine*. (*Taine*). *Expédition de Bonapart en Egypte*. (*Thiers*). *Ste. Elisabeth de Hongrie*. (*Montalembert*.) *Histoire de la Littérature Française* (*Duval*).

[Two hours a week for two terms.]

N. B.—The works studied are not necessarily the same every year.

Preparatory School.

THE PREPARATORY SCHOOL.

The University maintains a fully equipped Preparatory School under the same general government as the Colleges, but having its own special corps of instructors. The schedules of studies are arranged to meet the need of thorough preparation for collegiate work, and embrace courses which while giving as wide an education as can be obtained in the very best High Schools prepare students directly for the group of studies they may elect when entering the Freshman year. Five different programs of instruction are offered to students, each containing such special courses as directly meet the needs of the fifteen college groups, while all embrace common subjects which are indispensably necessary in acquiring a fairly liberal education. The period of instruction covers four years.

The equipment and facilities for study in the Preparatory School are most complete. The laboratories are extensive and fully equipped with the latest improved appliances. The classes pursuing any subject are divided into sections, each containing a limited number of students. The sections are thus purposely limited in order that the student may receive close attention from the instructor in every recitation and laboratory period.

Examinations for admission are held at the opening of the School in September and embrace the subjects completed in the highest grade in the Grammar School. The expenses for tuition, board, laundry, etc., and for special courses not listed in the programs will be found on pages 24, 25. The following fees are special to the Preparatory School;

LABORATORY FEES.

Science C.—Elementary Botany.....	\$ 2.50
Science D.—Elementary Zoology.....	2.50
Science E.—Elementary Chemistry.....	5.00
Science F.—Elementary Physics.....	5.00

BULLETIN OF THE
INSTRUCTORS IN THE PREPARATORY
SCHOOL.

REV. THOMAS H. CORBETT, C. S. C.,
Mathematics.

REV. WILLIAM MARR, C. S. C.,
Christian Doctrine.

REV. TIMOTHY MURPHY, C. S. C.,
Christian Doctrine.

BRO. ALEXANDER, C. S. C.,
Mathematics.

BRO. PHILIP NERI, C. S. C.,
Penmanship.

BRO. CYPRIAN, C. S. C.,
Bookkeeping and Commercial Law.

WILLIAM L. BENITZ, M. E., E. E.,
Mathematics.

EDWARD J. MAURUS, M. S.,
Mathematics.

SHERMAN STEELE, Litt. B., LL. B.,
English and Civics.

CHARLES PETERSEN, A. M.,
German.

ALPHAËUS B. REYNOLDS, A. B.,
English.

WILLIAM J. MAHONEY, A. B., LL. B.,
Mathematics.

JOHN QUINLAN, A. B.,
Mathematics.

UNIVERSITY OF NOTRE DAME.

83

THOMAS JAMES DEHEY, A. M.,
French.

JOHN B. RENO, A. M., LL. B.,
History and English.

CLARENCE J. KENNEDY, B. S.
Physiology, Zoology, Botany.

JOHN WORDEN, B. S.
Drawing.

TERENCE B. COSGROVE, A. B.,
Mathematics and Astronomy.

GALLITZEN A. FARABAUGH, A. B.,
History and English.

ARTHUR S. FUNK,
Chemistry.

MAURUS J. UHRICH,
Physics.

PROGRAM OF STUDIES PREPARATORY TO THE ENGINEERING DEPARTMENTS.

FIRST YEAR.

SUBJECTS FIRST TERM	Hrs. a Week	COURSE	SUBJECTS SECOND TERM	Hrs. a Week	COURSE
English - -	5	A	English - -	5	A
Mathematics	5	A	Mathematics	5	B
History - -	3	A	History - -	3	A
Science - -	5	A	Science - -	5	D
Civil Gov'm't	2	A	Civil Gov'm't	2	A

SECOND YEAR.

English - -	5	B	English - -	5	B
Mathematics	5	C	Mathematics	5	D
History - -	3	B	History - -	3	B
Science - -	5	B	Science - -	5	C
German - -	5	A	German - -	5	A

THIRD YEAR.

English - -	5	C	English - -	5	C
Mathematics	5	E	Mathematics	5	F
Science - -	5	E	Science - -	5	E
History - -	3	C	History - -	3	C
German - -	3	B	German - -	3	B

FOURTH YEAR

English - -	5	D	English - -	5	D
Mathematics	5	G	Mathematics	5	H
Science - -	5	F	Science - -	5	F
Science - -	2	G	Science - -	2	G
Drawing - -	3	A	Drawing - -	3	B

COURSES IN ENGLISH.

A.

(a) Meiklejohn's *Art of Writing English*, with daily exercises in class. Two themes a week.

(b) The elements of versification. Scansion, one hour a week. Weekly exercises in writing verse. Memory work.

(c) Required reading: *Robinson Crusoe*, **Evangeline*, *Treasure Island*, *Snow-Bound*, **The Sketch Book*, **The Vision of Sir Launfal*, Poe's *Tales*, Poe's *Poems*, *Fior-elli*, **Julius Caesar*, **The Merchant of Venice*,

(The works marked with an asterisk are to be studied ; the others read.)

[Five hours a week for one year.]

B

(a) Hill's *Principles of Rhetoric*. Part I., with daily exercises in class. Two themes a week.

(b) The simpler verse-forms. Weekly exercises.

(c) Required reading: *Ivanhoe*, **The Lady of the Lake*, *The Vicar of Wakefield*, **The Ancient Mariner*, *The Courtship of Miles Standish*, **Silas Marner*, **The Princess*, **Macbeth*, **As You Like It*.

(The works marked with an asterisk are to be studied ; the others read.)

[Five hours a week for one year.]

C.

(a) Hill's *Principles of Rhetoric*, Part II., with daily exercises in class. Weekly theme first term ; fortnightly essay second term.

(b) Verse-forms continued. Weekly exercises. Memory work.

(c) Required reading: **Sir Roger de Coverly*, **Mac-*

aulay's Essay on Addison, **The Golden Treasury of English Lyrics*, *Macaulay's Essay on Milton, *Milton's Minor Poems, **A Midsummer's Night's Dream*, *Burke's Speech on the Conciliation of America, *Webster's Bunker Hill Oration, *Lincoln's Gettysburg Oration, **King Lear*.

(The works marked with an asterisk are to be studied; the others read.)

[Five hours a week for one year.]

D

(a) Genung's *The Working Principles of Rhetoric*, Part I., with daily exercises in class. Fortnightly essay first term; monthly essay second term.

(b) Verse-forms concluded. Weekly exercises. Memory work.

(c) Required reading: *The House of the Seven Gables*, **The Idyll's of the King*, Selections from *Paradise Lost*, Cary's Dante, *Gates' *Selections from Newman*, **The Dream of Gerontius*, Pope's Homer, **The Tempest*, Aubrey de Vere's Poems, **Hamlet*.

(The works marked with an asterisk are to be studied; the others read.)

[Five hours a week for one year.]

COURSES IN HISTORY.

A

ANCIENT HISTORY — Fisher's *Outlines of Ancient History*. The Oriental Nations. The History of Greece and of the Empire of Alexander. The Story of Rome. The Establishment of the Empire, and the Rise of Christianity.

[Three hours a week for one year]

B.

MEDIEVAL HISTORY—Fisher's *Outlines of Medieval History*. The Barbarians and their Kingdoms. Mahomedanism and the Saracen Caliphs. The Holy Roman Empire. The Invasion of the Northmen and the Magyars. The Empire and the Papacy. The Crusades. The Great Schism and the rise of the nations of Modern Europe.

[Three hours a week for one year.]

C.

MODERN HISTORY—Fisher's *Outlines of Modern History*. The Renaissance. The Ages of Discovery. The Protestant Reformation. The Power of Spain. The Strifes of France with Spain and Germany. The Ages of Louis XVI., and the rise of Russia. The Spanish and Austrian Successions. The Empire of England. The American Revolution. The French Revolution and the Wars of Napoleon. The Revolutions and the Spirit of Nationality. The Formation of Germany and Italy.

[Three hours a week for one year.]

COURSE IN CIVIL GOVERNMENT.

A.

This is a study of the science of government in connection with American institutions, and is intended to give the student some knowledge of the general principles of government and the American Constitution. The subject begins by defining government; then is considered the object and necessity of government; origin of civil society; the principle of suffrage; different forms of government defined and compared; theories of repre-

sentation. These topics necessarily are treated briefly, as the principal part of the course consists of a study of the Colonial governments, the Articles of Confederation and their defects, the formation of the Constitution and its adoption. Now the study comprises a critical analysis of each article and section of the American Constitution, thus enabling the student to acquire a clear conception of the devision of powers of the National Government and the duties and responsibilities of each department. Text-book, *Government by State and Nation*, by James and Sanford.

[Two hours a week for one year.]

COURSES IN MATHEMATICS.

A.

ALGEBRA—This course for beginners in Algebra includes a study of the primary fundamental principles necessary to the courses which follow. The subjects dwelt upon in particular are Factoring, Highest Common Factor and Least Common Multiple, which are afterward applied in their relation to Fractions and the reduction of Complex Fractions. In as far as possible, concrete examples of their applications to kindred scientific subjects are supplied by the teacher. Text-book, *Wentworth*.

[Five hours a week for one term.]

B.

ALGEBRA—In this course the study of Equations is begun and continued through equations of the first degree. Fractional Equations, Systems of Simultaneous Equations, Involution, Evolution, Radicals and Exponents complete the course which is supplemented wher-

ever possible with problems of practical application.
Text-book, *Wentworth*.

[Five hours a week for one term.]

C.

ALGEBRA — This course begins with Quadratic Equations, Pure and Affected, followed by Systems of Simultaneous Quadratic Equations and those forms of Radical Equations of Higher Degree which may be solved by quadratic methods. Ratio and Proportion, Indeterminate Equations, Surds, Imaginaries, Inequalities, the Progressions and the Binomial Theorem finish the work in this course. As in the preceding courses, special stress is placed upon the application of the theory to such examples as will show its application to the elementary scientific subjects. Text-book, *Wentworth*.

[Five hours a week for one term.]

D.

GEOMETRY — This subject is completed as far as the end of Plane Geometry and includes a study of the theorems with proofs of exercises and original propositions. The habit of independent thinking is cultivated to some extent by the solution of special problems to concrete nature intended to exhibit the relation of the process studied to practical examples. Text-book, *Wentworth*.

[Five hours a week for one term.]

E.

GEOMETRY — The study of Solid Geometry is taken up in this term, the course being an extension of that of the preceding term. Planes, Solid Angles, Polyhedrons, the Cylinder, Cone and Sphere are all studied in detail and the solution of original exercises and proposi-

tions of application is made a feature of the course. Text-book, *Wentworth*.

[Five hours a week for one term]

F.

ALGEBRA AND GEOMETRY—This course which continues through one scholastic year is designed especially for those students who wish to take up the study of Engineering. As this necessitates a thorough ground work in mathematics, the first half of the year is given to a review of Algebra and Geometry, three hours and two hours per week respectively. The most important theorems and subjects are again studied and a more comprehensive view of the subject is attained in the generalizing of many theorems and extending the range of others. Text-book, *Benitz*.

[Five hours a week for one term.]

G.

ALGEBRA AND GEOMETRY—The work of this term is entirely given up to an elementary exposition of the application of mathematics to scientific problems and to analysis. In lectures and class work actual problems representing existing and practical conditions will be taken up, and the derivation of approximate formulæ and an elementary study of curves derived from experiment are included. Text-book, *Benitz*.

[Five hours a week for one term.]

H.

TRIGONOMETRY—A half a year is given to this subject which includes both Plane and Spherical Trigonometry. The work done is the equivalent of that in most of the elementary text-books. Special attention is given to Goniometry on account of its application to Calculus,

and examples of a concrete nature are abundantly supplied. Text-book, *Wetnworth*.

[Five hours a week for one term.]

COURSES IN SCIENCE.

A.

PHYSICAL GEOGRAPHY—An introductory and elementary study of the earth and its environments. The student will be led into a closer sympathy with the world about him. The various types of plant and animal life together with topographical and climatic conditions are considered. Text-book, *Tarr*.

[Five hours a week for one term.]

B.

PHYSIOLOGY—Lectures, recitations and demonstrations with the stereopticon. The study of the human skeleton including the physiology and hygiene of the bones. The action, relation, structure and hygiene of muscles. The digestive, circulatory and excretory systems demonstrated by models and charts. The anatomy and structure of the nervous system and simple experiments on the same. Text-book, *Martin*.

[Five hours a week for one term.]

C.

ELEMENTARY BOTANY—A course for beginners in this subject; it includes a study of the higher plants with reference to structure of root, stem, leaf, flower and seed. An introduction to the lower forms of plant life and their classification is also given. Text-book, Bastin's *Elements of Botany*.

[Five hours a week for one term.]

D.

ELEMENTARY ZOOLOGY—Includes an introduction to the subjects with studies of representative forms and their classification in the different groups of the animal kingdom. The subject is taught by recitations and laboratory work. Text-book, *Chapin and Rettger*.

[Five hours a week for one term.]

E.

(a) ELEMENTARY CHEMISTRY—An introductory course of experimental lectures on familiar subjects such as water, the air and its constituents, common salt, etc., leading up to discussions of the more important elements and their properties, and the fundamental laws and phenomena of Chemistry. Text-book, *Newell*.

[Three hours a week for two terms.]

(b) EXPERIMENTAL CHEMISTRY—A laboratory course to accompany Course (a). A series of one hundred exercises to be performed by each student, and having as their main object the cultivation of the student's powers of observation and faculty of inductive reasoning. These exercises comprise a study of the principal metallic elements, including their preparation, properties and more familiar compounds. The directions for each experiment are made as brief as possible, the observation of facts and the drawing of correct conclusions therefrom being left, so far as the nature of the experiment will permit, to the student.

[Two hours (four hours of actual work) a week for two terms.]

F.

(a) ELEMENTARY PHYSICS—Instruction in Elementary Physics is given by lectures and recitations in which the general laws of Mechanics, Heat, Acoustics, Optics,

Electricity and Magnetism are presented. The course is intended to meet the needs of those who desire a general knowledge of the subject, as well as to lay the foundations for advanced work. Particular attention is paid to the correct statement of principles, so that in his advanced work the student will have nothing to unlearn or relearn. Text-book, *Carhart and Chute*.

[Three hours a week for two terms.]

(b) THE LABORATORY WORK of this course consists of a series of experiments which verify and apply practically the fundamental principles of Physics. The student also receives instruction in the use and careful handling of apparatus, accurate observation, and correct deduction of results. Neat and concise reports of all experiments are kept by each student and form the basis for the grades in his work.

[Two hours (four hours of actual work) each week
for two terms]

G.

ASTRONOMY-DESCRIPTIVE—This course is intended to give students as much knowledge of astronomical facts as can be obtained with only an elementary training in mathematics. The study consists of a description of the earth; its form, size, density and motion; a study of the moon and her motions; the sun and its relation to the earth: an account of eclipses, refraction and aberration of light. A description of the planets, their distances, dimensions, and physical conditions; a study of parallax, diurnal and annual; an account of meteors and comets. A study of the stars and constellations; instruction is given to enable students to name and locate the more prominent. The subject of Cosmogony is considered briefly as well as an explanation of the different systems of Astronomy. The subject is given both by lectures

and text-book. Text-book, *Young's Lessons in Astronomy*.
[Two hours a week for two terms.]

COURSES IN FRENCH.

A.

Grammar with written and oral exercises; the inflection of nouns and adjectives, the use of all the pronouns, the conjugation of regular and the common irregular verbs; the correct use of moods and tenses, the essentials of French syntax, and the common idiomatic phrases. Reading three of the following: Houghton's *French by Reading*. *La Tâche du Petit Pierre*. (*Mairet*). *Un Cas de Conscience*. (*Gervais*). *La Main Malheureuse*. (*Guerber*). *Sans Famille*. (*Malot*). *Super's Readings from French History*.

[Five hours a week for two terms.]

B.

Advanced grammar and composition, study of idioms, memorizing. Dictations and conversations are added on practical topics, and careful translation made of two or three of the following works: *Le Voyage de M. Perichon*: (*Labiche*). *Roman d'un Jeune Homme Pauvre*. (*Feuillet*). *Fables choisies*. (*La Fontaine*.) *Le Médecin Malgré Lui*. (*Molière*). *Le Cid*. (*Corneille*). *Esther*. (*Racine*). *Pages oubliées de* (*Chateaubriand*). *La Question d'Argent*. (*Dumas*). *Standard French Authors*. (*Guerlac*.)

[Three hours a week for two terms.]

C.

The study of this course is devoted chiefly to the prose and poetry of the nineteenth century and includes composition, conversation, history and general view of

French literature. Besides a reading and criticism of the best writers, such as: *Causeries du Lundi*. (*Ste. Beuve*). *On Rend l' Argent* (*Coppée*). *Hernani*. (*Hugo*). *Méditations* (*Lamartine*). *Athalie*. (*Racine*). *L'Avare*. (*Molière*). *Mlle. de la Seiglière*. (*Sandeau*). *Les Origines de la France Contemporaine*. (*Vain*). *Expédition de Bonaparte en Egypte*. (*Thiers*). *Ste. Elizabeth de Hongrie*. (*Montalembert*). *Histoire de la Littérature Française*, (*Duval*).

[Two hours a week for two terms.]

N. B.—The works studied are not necessarily the same every year.

COURSES IN GERMAN.

A.

Grammar, *Joynes-Meissner*, Part I. Translation from German into English of simple prose; translation of English exercises into German. Reading of short stories and selections from more difficult prose.

German Reader, *Miller and Wenkelbach*.

[Five hours a week for two terms.]

B.

Grammar, *Joynes-Meissner*, Part II. Translation into German of narrative prose and selections from history. Rapid reading of selections from history.

Herman and Dorethea (*Goethe*); *Lichtenstein* (*Hauff*).

[Three hours a week for two terms.]

C.

Grammar, *Joynes-Meissner*, Part III. Rapid reading of plays, poems and prose writings. Translations of selections from history and literature; original essays.

Minna von Barnhelm (*Lessing*); Best known poems, (*Heine*); Correspondence (*Schiller-Goethe*.)

[Two hours a week for two terms.]

COURSES IN DRAWING.

A.

This course is based on the rudiments of drawing and consists of the training necessary for the hand and the eye. Sketching is also done from simple objects of various forms.

[Three hours a week for one term.]

B.

Advanced work in sketching from objects such as the plaster cast of flowers and suitable ornaments which afford the study of light and shade.

[Three hours a week for one term.]

GRAMMAR SCHOOL WORK.

The Courses of the Preparatory Department outlined above are equivalent to those of a High School. There is also a Junior Preparatory Department in which are taught all the branches of a Grammar School,—the students have every opportunity of preparing themselves as rapidly as possible for High School work.

NEEDS OF THE UNIVERSITY.

Visitors to Notre Dame judge from the appearance of the buildings and grounds that the University has no need of money. It is, nevertheless, absolutely without endowment, and its work is seriously hampered because it has no resources except the fees of students. There are two scholarships and the interest from these foundations is used in educating and boarding two students.

There were in 1901 1,452 Catholic students in 6 per centum of the non-Catholic colleges of America, and very many of these will lose their faith, and all will be weakened in that faith, because our people look upon collegiate institutions as the property of private corporations which are to be left to take care of themselves.

Notre Dame asks for scholarships for boys that can not pay the expense of education, and who therefore are obliged to go to non-Catholic colleges to the detriment of their faith. A foundation of \$8,000 will educate and board a student as long as the University exists. As one bursar is graduated another can take his place. The founder of the scholarship, of course, always has the privilege of appointing the student.

We lack money for a library building, and for two more dwelling-halls like Sorin Hall.

Foundations for scholarships are also a pressing need.

There is no Library fund for the purchase of new books.

The names of benefactors will be given to all foundations.

BEQUESTS SHOULD BE MADE IN THIS FORM :

UNIVERSITY OF NOTRE DAME DU LAC.

I give, devise and bequeath to the UNIVERSITY
OF NOTRE DAME DU LAC, an institution incor-
porated under the laws of the State of Indiana, and
located at Notre Dame, Indiana.....



THE UNIVERSITY OF NOTRE DAME — BIRD'S EYE VIEW.